AUGUST, 1934.

GENERAL PHYSICS.

ADSORPTION.

3069. Tenacity of Active Carbons for Vapour. Part IV. F. Krczil and H. Wejroch. *Kolloid Zeits.* 67. *pp.* 277–279, *June*, 1934.—When an indifferent gas is passed over a carbon charged with vapour, the proportion of the original charge of vapour which is retained is independent of the formation of the carbon layer. [For Parts II and III see Abstract 2673 (1934).] T. H. P.

3070. Hysteresis in Silica Gel Sorption Systems. L. M. Pidgeon. *Canad. J. of Research*, 10. *pp.* 713–729, *June*, 1934.—The sorption of water, benzene and ethyl alcohol has been examined using the sorption balance. A hysteresis loop appears for water only. This hysteresis may not be eliminated by special methods of evacuation and must be considered as a real effect. The isotherms of alcohol and benzene, on the other hand, are completely reversible. It has been shown that the dimensions of the hysteresis occurring in the water system may be affected by the manner of addition of vapour to the apparatus. Only when the vapour pressures remain reasonably constant during sorption are the dimensions of the effect evident. If very large pressure changes take place the hysteresis may disappear. A comparison of the isotherms for water showing hysteresis, and those of the SO_2 system (upon which the original suggestion as to the cause of hysteresis was based) shows that there is not necessarily any relation between the two. AUTHOR.

3071. Sorption of Methyl and Ethyl Alcohols by Silica Gels. A. B. Foster. *Roy. Soc., Proc.* 146. *pp.* 129–140, *Aug.* 1, 1934.—Sorption isothermals of MeOH and EtOH have been determined on two samples of silica-gel at 25° C. The isothermals on the two types of gel are similar at low pressures, and all four show a linear range at intermediate pressures. At higher pressure the gel with the higher capacity exhibits a well defined hysteresis area, which is reproducible, and is not affected by drastic flushing out, or by evacuation at 350° C. The different behaviour of the two types of gel is attributed to a simple difference in capillary structure. The pressures at which hysteresis occurs correspond to a constant capillary radius as calculated by means of the Kelvin equation. AUTHOR.

3072. Behaviour of Hydrogen Dissolved in Palladium. K. F. Herzfeld and Maria Goeppert-Mayer. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 203–208, 1934.—The discovery of Coehn and Jürgens [see Abstract 189 (1932)] that an electric current in a H_2-charged Pd wire carries H_2 along with it has led to the assumption that the dissolution is accompanied, at least partly, by a dissociation into protons and electrons. From a circular process Franck has calculated the work necessary to remove a dissolved proton from Pd as 11 volts and has expressed the view that this energy is derived, partly at least, from a cloud-formation of the free metallic electrons round the proton, as is the case, according to the Debye-Hückel theory, in ion solutions. The calculations for the energy and the conductivity are now extended to electrons obeying the Fermi statistics. T. H. P.

3073. Surface Properties of Colouring Matters. E. Vellinger and R. Déllon. *Comptes Rendus*, 198. *pp.* 2084–2086, *June* 11, 1934.—The interfacial tension, paraffin/aqueous solution of bromthymol blue, has been measured as a function of the pH of the solution. The surface activities of the undissociated dye and the anion are different.

A. S. C. L.

See also Abstract 3405.

ATOMIC AND MOLECULAR STRUCTURE.

3074. Constitution of Atomic Nuclei. Part I. K. Guggenheimer. *J. de Physique et le Radium*, 5. *pp.* 253–256, *June*, 1934.—Assuming that atomic nuclei consist of neutrons and protons, curves are constructed showing the relation between the numbers of these particles in such elements as are known. From a study of possible stable groupings it is deduced that α-particles are not the principal primary components of nuclei. It is proposed that elements having the same number of neutrons, but different atomic numbers shall be termed " isotones."

J. E. R. C.

3075. Energy and Stability Related to Composition of Atomic Nuclei. E. D. Eastman. *Phys. Rev.* 46. *pp.* 1–16, *July* 1, 1934.—Examination of the postulates of Heisenberg concerning the energy of binding of neutrons and protons to atomic nuclei shows that factors not included in the primary considerations are of appreciable effect in determining nuclear composition and stability, and result in deviations of a periodic character from the requirements of the theory. Nevertheless, the formulation of binding energies as linear functions of the neutron-proton ratio of the nucleus is adequate as a rough approximation over a large range of elements, as is also the proportionality assumed between the radius and the cube root of the mass number. For evaluation of the various constants, it is assumed that the boundary of stability in emission of β-particles should be centrally placed with respect to existing nuclear species. Reasons supporting this placement, and the manner of adjustment of the α-boundary, for which the distribution of nuclei alone is not an adequate guide, are outlined. The application in various fields of nuclear physics and chemistry of the constants thus determined is discussed and illustrated. The " end " of the periodic system and the limiting spread in mass numbers of isotopes as influenced by the various types of nuclear instability are also discussed. AUTHOR.

3076. Transmutation of Fluorine by Proton Bombardment and the Mass of Fluorine 19. M. C. Henderson, M. S. Livingston and E. O. Lawrence. *Phys. Rev.* 46. *pp.* 38–42, *July* 1, 1934.—Fluorine has been transmuted by bombardment with protons into oxygen and helium. The number of transmutations has been followed from a proton energy of 0·675 to 1·63 × 10^6 electron-volts. The α-particles emitted have a range greater than 6 cm. Their range increases with proton energy in the expected manner. The short range α-particles observed both by us and by other workers are probably due to a boron contamination. Oppenheimer has calculated, along the lines of the Gamow theory, the manner in which the probability of transmutation should vary with the energy of the protons. The measurements are in excellent agreement with the theory. The mass of the fluorine atom that is calculated from the reaction, 19·0031, is in excellent agreement with other transmutation data, but not with the value usually accepted, namely 19·000. AUTHORS.

3077. Inter-Relations of Hydrogen and Deuterium Molecules. A. J. Gould, W. Bleakney and H. S. Taylor. *J. Chem. Phys.* 2. *pp.* 362–372, *July*, 1934.—It has been shown that neither stopcock grease nor water in a pyrex or soft-glass vessel affect the concentration of H_2-D_2 mixtures. Diffusion through Pd gives a concentration of the isotopes which is about that to be expected from an atomic diffusion process. Desorption from charcoal at liquid-air temperatures gives the concentration effect to be expected from a diffusion as molecules. Mercury, pyrex and soft-glass surfaces at room-temperature and charcoal at liquid-air temperatures do not promote the reaction between H_2 and D_2. Chromium oxide and nickel-kieselguhr surfaces promote the reaction in the temperature range − 190° to 110° C. A palladium surface catalyses the reaction at 270° C. Experimental values have been obtained for the equilibrium constant of the reaction from the temperature of liquid air upwards, in accord with theoretical calculations by Urey and Rittenberg based on statistical mechanics. AUTHORS.

3078. Isotopes of Rare Earth Elements. F. W. Aston. *Roy. Soc., Proc.* 146. *pp.* 46–55, *Aug.* 1, 1934.—Experiments are described by means of which adequately intense beams of anode rays of the rare earth elements have been obtained. The results of analysis of these by the mass-spectrograph are given providing a provisional survey of the isotopic consitutions of all the elements in the group. During the work more than thirty new isotopes have been discovered. Estimates of the percentage abundances of each isotope are given from which the chemical atomic weights of the elements are calculated. Serious errors in the international table of atomic weights for 1934 are indicated. AUTHOR.

3079. Energies of the Atomic Linkages in the Normal Paraffin Hydrocarbons. F. D. Rossini. *Nat. Acad. Sci., Proc.* 20. *pp.* 323–327, *June*, 1934.—Calculations have been made of the values of $\Delta = (Da)^0_0 - [(2n + 2)a + (n - 1)b - nE_c]$, where $(Da)^0_0$ is the energy absorbed at 0° K. in the dissociation of the gaseous molecule C_nH_{2n+2}, E_c the energy of excitation of the C atom and *a* and *b* the values assigned to the C − H and C − C bonds respectively. These values, which have been supposed to be zero for all paraffin hydrocarbons, vary from 4·81 for methane to 0·13 for normal pentane and to zero for higher normal hydrocarbons. Thus, the energy of dissociation of the gaseous normal molecule C_nH_{2n+2} into gaseous C and H atoms is a linear function of *n* above, but non-linear below, $n = 6$. The deviations are in the direction of greater stability of the molecule. These results are explained on the basis of a distinction between the various kinds of C − H and C − C bonds in these hydrocarbons. T. H. P.

3080. Structure and Properties of Active Zinc Oxides. G. F. Hüttig. *Kolloid Beihefte*, 39. 8–12. *pp.* 277–333, 1934.—The preparations of the various active oxides are described at length and also the kinetics of the reactions involved. Then follows the complete study of the X-ray diagrams; densities (by pyknometer); adsorption capacities for methanol vapour and soluble dyestuffs; microscopic pictures; sedimentation analysis; solubilities; magnetic susceptibilities and volumes; specific heats and energy contents; fluorescence; and catalytic properties. The experimental results indicate that the individual peculiarities of the active zinc oxides depend upon (*a*) the nature of the pore system, (*b*) defects of crystal structure, and (*c*) the relationships in which the various crystallographic lattice planes are concerned over the entire surface. It is concluded that the existence and characteristics depend upon single phase transitions between the crystalline and amorphous states. One Appendix contains a Bibliography of 35 publications on the active oxides, and a second collects together the entire literature on the subject from 1924 to 1932. H. H. Ho.

3081. Structure of the Carboxyl Group. Part I. Investigation of Formic Acid by the Diffraction of Electrons. L. Pauling and L. O. Brockway. *Nat. Acad. Sci., Proc.* 20. *pp.* 336–340, *June,* 1934.—By determination of the interatomic distances in formic acid, the resonating structure which has been suggested for the double linking between the two O-atoms of the $-COOH$ group has been confirmed. It is shown also that in the dimeride of formic acid, the two molecules are joined together by H bonds between the O atoms of the $-COOH$ groups. [See following Abstract.] T. H. P.

3082. Structure of the Carboxyl Group. Part II. Crystal Structure of Basic Beryllium Acetate. L. Pauling and J. Sherman. *Nat. Acad. Sci., Proc.* 20. *pp.* 340–345, *June,* 1934.—Laue and oscillation photographs of this salt have been made and are discussed in relation to the molecular structure. The molecules consist of four BeO_4 tetrahedra with one common corner, the remaining corners being occupied by oxygen atoms of the acetate groups; the distance $Be - O$ is 1·65 Å. The tetrahedra are slightly distorted, and in the acetate group the angle 1 has the value 124 ± 3°, which is equal to the value (125 ± 5°) found with formic acid. It is concluded that this value of the bond angle in the carboxyl group is probably retained in all aliphatic acids. [See preceding Abstract.] T. H. P.

3083. Physico-Chemical Problems in Organic Chemistry. E. Hertel. *Zeits. f. Elektrochem.* 40. 7*b. pp.* 405–413, *July,* 1934.—A review of the subject delivered as an opening address at the meetings of the Bunsengesellschaft in Bonn, May, 1934. One of the chief aims of physico-chemical research is to control, extend and to make more precise the geometrical model of organic molecules, *e.g.*, by the determination of angles, by dipole studies of cis-trans-isomers, by the determination of the absolute configuration of optically-active compounds, and by the investigation of free rotation. Physico-chemical methods superpose on the geometrical model an energy model, which allows the physical and chemical behaviour of the molecule to be interpreted. They allow of the investigation of the inner-molecular forces (as in the case of vibration-rotation spectra, and in the identification of localised and free electrons), and also of the surfaces of molecules and the force fields surrounding them. Recent results obtained by four methods of attack are discussed, namely, light absorption, electron bombardment, the study of atoms and free radicals, and the investigation of collision processes. C. B. A.

3084. Space Configuration of Molecules and Molecular Aggregates. H. Mark. *Zeits. f. Elektrochem.* 40. 7*b. pp.* 413–424; *Disc.,* 424, *July,* 1934.—An account of the application of X-ray methods to the study of the structure of organic molecules. On account of complexity of the lattice types, their low order of symmetry, and the difficulty of preparing suitable crystals, it is not possible to elucidate the structure of more complicated molecules (*e.g.*, silicates, fatty acids, aromatic compounds, cellulose, rubber, etc.) directly from X-ray measurements. The method adopted is that developed by W. H. and W. L. Bragg, *viz.*, to collect systematically for a large number of similar substances, data for

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symmetry, axial ratios, lattice dimensions and type, and the X-ray interference patterns, and to interpret this material in the light of known physical and chemical properties of the substance. The molecular structure thus deduced is not necessarily the correct one, but it at least has a high degree of probability. A series of problems of particular chemical interest, including those of free rotation and of the formation of molecular aggregates, are discussed in this way, the necessary data being tabulated.
C. B. A.

3085. Physical Properties and Association of Hydrides of Elements of the Fifth Group. Agnes A. Durrant, T. G. Pearson and P. L. Robinson. *Chem. Soc., J. pp.* 730–735, *June*, 1934.—A recent investigation of the hydrides of the sixth-group elements [see Abstract 2725 (1932)] afforded many interesting results such as the association of water and H_2S as shown by surface tension data. This work has now been extended to hydrides of the fifth group, whereby the association of NH_3 and PH_3 has been demonstrated. The latent heats of vaporisation at the boiling point, when plotted against period number, show an upward inflexion corresponding to that in similar plots of the boiling point and the surface tension. The values deduced for the parachors indicate a positive anomaly in those of PH_3, AsH_3 and SbH_3; this finds a parallel in the negative anomaly in HCl, HBr and HI, but the hydrides of the intermediate group S, Se and Te are normal.
H. H. Ho.

3086. Volatile Hydrides. Part I. Periodicity. Part II. Parachors, Molar Volumes and Electronic Structures. T. G. Pearson and P. L. Robinson. *Chem. Soc., J. pp.* 736–743, *June*, 1934.—In Part I a complete survey of the physical properties of the volatile hydrides has been made and it is established (*a*) that in any group the melting and boiling points, molar heats of vaporisation, molar volumes, and surface tensions vary directly with the period numbers of the parent elements, (*b*) that the difference in the values of the physical constants of contiguous members of a group tends to be the same as that between the corresponding inert gases, and (*c*) that departure from linearity when a physical property is plotted against period is due to association. With the aid of these generalisations, values for the undetermined physical constants of Kr, Xe, Rn and the hydrides of C, Si, Ge, Bi, Po and eka-I have been ascertained. In Part II it is demonstrated that the parachor of H in volatile hydrides has a different value according to the element to which it is united, being smallest in the halogen hydrides and greatest in the metallic hydrides. A survey of all the existing data has shown that the ratio $MV_{b.p.}/MV_0$ is constant for each periodic group, whilst a comparison between parachor and MV_0 indicates that for associated liquids, the former provides the more reliable means of comparing molecular dimensions. H. H. Ho.

3087. Atomic Weight of Calcium in Old Potassium-Rich Minerals. W. W. Smith and T. Tait. *Roy. Soc. Edinburgh, Proc.* 54. 1. *pp.* 88–101, 1933–1934.—Ca was extracted from Portsoy (I) and Rhiconich (II) pegmatites, of estimated ages 400 and 1000 × 10^6 years respectively. The atomic weight of Ca from (I) was 40·089, from (II) 40·092, compared with 40·076 – 40·077 for Ca from modern sources (recent limestone and marine shells). The excess of about 0·013 in the atomic weight of Ca from the old minerals is attributed to the presence of Ca^{41} formed by disintegration of K^{41}, for which a half-life period of 1×10^{11} yr. is accordingly deduced [see Abstract 2962 (1931)]. C. A. S.

3088. Molecular Weights of Highly Polymerised Substances. M. Ulmann. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 451–455, *July*, 1934.—A method of determining osmotic pressure, based on the principle of isothermal distillation, using a semipermeable porous plate, which has proved highly successful, is described. It allows of accurate investigation of extremely dilute solutions of highly polymerised substances at concentrations where other methods are inapplicable. An account is given of the application of the method to various problems, *e.g.*, depolymerisation of α-dextrin in aqueous solution, and the decomposition of hendexamethylcellotriose, in dependence on pH ; thixotropy ; investigations of the various fractions in technical acetyl cellulose ; etc. C. B. A.

See also Abstracts 3100, 3101, 3103, 3151, 3175, 3176, 3231, 3232, 3237, 3239, 3252, 3288, 3290, 3293, 3294, 3295, 3296, 3307, 3308, 3314, 3315, 3331, 3393, 3406.

COLLOIDS.

3089. Eucolloids. Wo. Ostwald. *Kolloid Zeits.* 67. *pp.* 330–333, *June*, 1934.—It is pointed out that the idea of a " eucolloid " originated from Wo. Ostwald, and that at present it is used in literature in a double sense, *viz.*, the original meaning, proposed by Ostwald and utilised also in the earlier publications of Staudinger, of a colloid whose particles are built up and held together by primary chemical affinities (chief valencies), *i.e.*, colloidal matter. This conception is identical with that of molecular colloid, macromolecule, chief valency chain, etc. Later, Staudinger used the term in a special fractional sense within the more comprehensive domain of the Ostwald eucolloid and restricted to molecular weights between 10^4–10^6. The present note is written to prevent misunderstanding. H. H. Ho.

3090. Lyophilic Colloids. Part I. Coacervation. L. W. J. Holleman, H. G. B. de Jong and R. S. T. Modderman. *Kolloid Beihefte*, 39. 8–12. *pp.* 334–420, 1934.—Coacervation is defined as the reversible separation of a liquid layer colloidally rich from sols of lyophilic colloids, and it occurs when the stability conditions (charge and solvation) are disturbed. This paper contains a most comprehensive study of simple coacervation in gelatin sols, and is divided into 3 main sections. Part I reviews the subject generally. Part II deals with the simple coacervation of gelatin and contains a study of the chemical composition of both layers of coacervation as a boundary layer phenomenon, and of transition from the sol to the coacervation state. Part III is concerned with the kinetics of the process and considers structural differences between sol and coacervate, the analogy between the coacervation of a lyophilic sol and the condensation of a gas. H. H. Ho.

3091. Preparation of Colloidal Solutions by Silent Electric Discharges. S. Miyamoto. *Kolloid Zeits.* 67. *pp.* 284–288, *June*, 1934.—By means of the apparatus and method described, hydrosols of Au, Ag, Pt and Pd, and Au- and Ag-organosols have been prepared. T. H. P.

3092. Mechanical Coagulation. W. Heller. *Comptes Rendus*, 198. *pp.* 1776–1778, *May* 14, 1934.—Mechanical agitation coagulates hydrophobic sols, the effect being greatest in the least stable ones. It is suggested that the ζ potential must be below a certain critical value for coagulation to occur. A. S. C. L.

3093. Ionic Interchange in Sulphur Sols. Mechanism of Coagulation. T. R. Bolam and J. J. Muir. *Chem. Soc., J. pp.* 754–766, *June*, 1934.—It is found that a close relationship always exists between the coagulative action of a salt and the replacing capacity of the kation under the given conditions. The conclusion is drawn that the ionic interchange is an essential part of the coagulation mechanism. It is shown that the coagulation may be reasonably regarded as due to diminution of the actual charge on the sulphur surface by the formation of unionised molecules, or complexes, between the coagulating kations and the micellar polythionic anions. The effect of any given factor on the coagulation value is interpreted in terms of (1) variation in the specific ionising tendency of the surface molecules, or complexes, and (2) variation in the concentration, or activity, of the coagulating ions. Adsorption of sulphuric acid by the colloidal sulphur is shown to occur, but no evidence has been found that such adsorption is a stabilising factor. AUTHORS.

3094. Action of an Electric Current upon Gels. J. Swyngedauw. *Comptes Rendus*, 198. *pp.* 2098–2100, *June* 11, 1934.—Effects of electrolysis upon gels in the presence of electrolytes are described. Shrinkage of gel occurs at anode or kathode according to pH of system. A. S. C. L.

3095. Rise of Colloidal Solutions in Porous Bodies. A. Boutaric. *Comptes Rendus*, 198. *pp.* 2247–2249, *June* 25, 1934.—When a colloidal solution is allowed to rise in a strip of filter paper, the colloid is precipitated as a separate layer only when charged positively. When the charge is negative, the colloid rises with the dispersion medium. A. S. C. L.

3096. Porosity of Dispersoids. Z. W. Wolkowa. *Kolloid Zeits.* 67. *pp.* 280–284, *June*, 1934.—By means of a simple apparatus the penetration of various liquids into powders has been measured. The mean penetration radius $r = \pi^2 l^2 \eta / 2t\delta$ is taken as the dispersoid-analytical characteristic of the mineral dispersoid and as an estimate of the physico-chemical reciprocal action between the solid powder surface and the liquid. With non-polar liquids r remains constant for one and the same powder, but it diminishes on passing to polar liquids and is especially small for water. The diminution for polar liquids is explainable by the peptising action of these liquids on powdered clay, by the formation at the surface of the powder of orientated liquid layers, which remain unmoved during flow, by swelling of the powders, or by wetting-hysteresis for water. For displacement of non-polar liquids from the powder surface by water, the simple law $l^2/t =$ const. holds, since the penetration radius for water is too small in relation to the r- value for benzene. By means of t-l measurements the wetting isotherms C, B $= \cos\theta$ may be obtained, C being the concentration of surface-active substance forming orientated adsorption layers at the surface of the powder. T. H. P.

3097. Effect of Non-Electrolytes upon Diffusion in Gelatin Gels. L. Friedman and W. N. Shearer. *Am. Chem. Soc., J.* 56. *pp.* 1323–1324, *June*, 1934.—The effect of methanol, urea, glycerol, glucose and sucrose upon the diffusion velocity of urea in gelatin gels has been determined. These non-electrolytes caused an increase in diffusion velocity at low concentrations up to a maximum at concentrations of 0·006 to 0·04 *M*. At higher concentrations there was a lessening of this effect until finally there was a decrease above 0·08 to 0·18 *M*. These results have been explained by assuming that non-electrolytes influence diffusion in gels in two ways: (1) by increasing the radii of the pores within the gel due to a decrease in the hydration of the solid phase, and (2) by

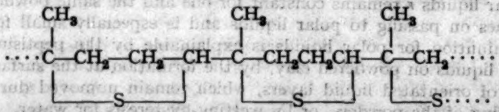
increasing the viscosity of the medium through which diffusion takes place.
AUTHORS.

3098. Rhythmic Precipitates. Part III. T. Isemura. *Chem. Soc. Japan, Bull.* 9. *pp.* 236–239, *May,* 1934.—The effects of fatty acids, amino-acids and alcohols upon the rhythmic precipitation of silver chromate in gelatin gels have been observed and are described. Caproic and caprylic acids form distinct bands of their silver soaps. [For Part II see Abstract 2689 (1933).]
A. S. C. L.

3099. Periodic Precipitation by the Two-Drop Method. Suzanne Veil. *Comptes Rendus,* 198. *pp.* 1854–1856, *May* 23, 1934.—The method in which a drop of a solution of one of the reactants is placed upon a gelatin film impregnated with the other is not entirely satisfactory. It is better to place drops of the two solutions at a suitable distance apart on a gelatin film and observe the reaction as the solutions diffuse towards one another. Zinc salts form striated precipitates with potassium chromate solution. Application of the two-drop method has led to the discovery of several new periodic reactions [see Abstract 1282 (1933).]
H. F. G.

3100. Molecular Weight of Sol Rubber. T. Midgley, Jr., A. L. Henne, A. F. Shepard and Mary W. Renoll. *Am. Chem. Soc., J.* 56. *pp.* 1325–1326, *June,* 1934.—Partially vulcanised rubber has been fractionated into components in which rubber is combined with increasing amounts of sulphur. The analyses of these fractions concur to indicate a molecular weight of about 54,000 for the particular sample of rubber used. Specimens of varied origin, can thus have their molecular weight measured by strictly orthodox chemical means.
AUTHORS.

3101. Structural Formula for Ebonite. T. Midgley, Jr., A. L. Henne and A. F. Shepard. *Am. Chem. Soc., J.* 56. *pp.* 1326–1328, *June,* 1934.—A formula for ebonite has been proposed, where sulphur is linked to a carbon atom bearing a methyl group on the one side and to the next third carbon atom of the rubber chain on the other side



$$\cdots\underbrace{\overset{CH_3}{\overset{|}{C}}-CH_2-CH_2-CH}_{S}-\underbrace{\overset{CH_3}{\overset{|}{C}}-CH_2CH_2CH}_{S}-\underbrace{\overset{CH_3}{\overset{|}{C}}}_{S\cdots\cdots}-CH_2\cdots\cdots$$

This formula is based on a consideration of the pyrolysis products of ebonite.
AUTHORS.

3102. Mathematical Treatment of a Theory of Rubber Structure. T. R. Griffith. *Canad. J. of Research,* 10. *pp.* 486–520, *May,* 1934.—A stress-strain curve is developed mathematically on the assumption that the elasticity of rubber is due to the heat vibrations of very long chain molecules bound to one another at occasional points along their length but able to move freely at all other points. The curve obtained is a reasonably close approximation to the curve obtained experimentally. Calculated values are given for the average distance between junction points, the average length of molecular chain between junction points, the quantity of kinetic energy per c.c. causing the elastic effect in rubber and the percentage of sulphur necessary to form the junction points in vulcanised rubber.
J. K.

3103. Structure of Unstretched Rubber by Electron Diffraction. G. Bruni and G. Natta. *Accad. Lincei, Atti.* 19. *pp.* 536–540, *April* 22, 1934.—X-ray examination of rubber at ordinary temperatures yields photograms similar to those given by liquids, a crystal structure being revealed only if the rubber is stretched or frozen. A number of thin films (some ten-thousandths of 1 mm. thick) of Para and smoked sheet rubber have now been examined in the unstretched state by means of the interference of rapid electron rays. The photograms show, besides a diffuse blackening, also certain more or less sharp lines, which are common to all the samples examined; the calculated value of the period of identity varies in the different photograms from 8·1 to 8·4 Å. Thus, the rubber shows an orientated structure, and the hypothesis that the molecules in thin, unstretched sheets are arranged in a contracted spiral form must be abandoned. T. H. P.

3104. Diffraction of Electrons by Rubber. J. J. Trillat and H. Motz. *Comptes Rendus*, 198. *pp.* 2147–2149, *June* 18, 1934.—Investigation of thin rubber films by means of electron diffraction show that such films are doubly-refracting, thus confirming the conclusion of Katz and others, and possess an unstable pseudo-crystalline structure produced in making the films. The isoprene chains in films produced by stretching are arranged parallel to the plane of the film. J. S. G. T.

3105. Cell-Space Ratio in Wood by a Photoelectric Method. W. W. Barkas. *Phys. Soc., Proc.* 46. *pp.* 545–558; *Disc.*, 558–559, *July* 1, 1934.—A method for measuring the cell-space ratio, or proportion of void space, in wood depends on measuring, by photoelectric means, the amount of light passing through a stained microsection of the wood. A correction for the amount of light penetrating the stained cell-wall is necessary. Comparisons are made between the results obtained by this method and those obtained by the use of a Shand's micrometer, and the conclusion is drawn that the photoelectric method is the more accurate and very much the more rapid. A description of the photoelectric amplifier is given. AUTHOR.

See also Abstracts 3070, 3088, 3164, 3165, 3166, 3337.

CRYSTAL STRUCTURE AND PROPERTIES.

3106. Catalytic Properties and Structure of Metal Films. Part II. Electrical Condition of Platinum Films. G. I. Finch and (Miss) A. W. Ikin. *Roy. Soc., Proc.* 145. *pp.* 551–563, *July* 2, 1934.—The surface potentials and rates of charging-up of sputtered Pt films in contact with electrolytic gas at room-temperature have been determined, and the film structures examined by the method of electron diffraction. It has been found *inter alia* that (i) electrically active films were also catalytically active, whilst electrically neutral films were inert as catalysts; (ii) the rates at which active films promoted the union of H_2 and O_2 were directly proportional to their rates of charging-up; (iii) with the more active films, the crystals were arrayed at random, whereas with inactive films a considerable proportion of crystals possessed a common direction of orientation; (iv) the diffuse background in electron diffraction patterns obtained from active films increased in intensity with increasing activity; (v) heating rapidly destroyed the latent activity of a film and when sufficiently prolonged also broke down the crystal structure. From these facts in conjunction with those set forth in Part I [see Abstract 3896 (1933)] it is concluded that, under the conditions of these experiments, (i) catalytic action was determined by a prior interaction between the surface and one or both constituents of the combining mixture, whereby the catalyst became electrically charged; (ii) activity was not determined by either crystal size or orientation; (iii) catalytic activity may have been centred around atoms of platinum not forming part of any ordered array or structure. AUTHORS.

3107. Effect of Thermal Agitation on Atomic Arrangement in Alloys. W. L. Bragg and E. J. Williams. *Roy. Soc., Proc.* 145. *pp.* 699–730, *July* 2, 1934.—An alloy phase has two characteristics. The first is the pattern of sites occupied by atoms irrespective of their nature. Each phase of an alloy system has a different pattern of sites, and therefore a change from one phase to another involves their complete re-arrangement. The second characteristic is the distribution of the atoms amongst these sites. This distribution may vary continuously without change of phase, from being random at high temperatures to being partially regular at low temperatures. The alloy is a system of dynamical equilibrium. Although interchange of atomic position at room-temperature is infrequent, the alloy has received its character at some previous point in its history when the temperature was just sufficiently high for interchange to be important. Maxima and minima in physical properties at certain relative proportions (*e.g.*, Fe_3Al and $AuCu_3$) are statistical effects, and do not imply the existence of corresponding compounds. AUTHORS.

3108. Ammonium and Potassium Molybdo-Tellurates, Two Homeomorphous Orthorhombic Substances. J. D. H. Donnay and J. Mélon. *Nat. Acad. Sci., Proc.* 20. *pp.* 327–335, *June,* 1934.—$3(NH_4)_2O$, TeO_3, $6MoO_3$, $7H_2O$ forms dipyramidal or holohedral orthorhombic crystals, of density $2{\cdot}78 \pm 0{\cdot}02$ and hardness 2·5 (Mohs' scale); $a : b : c = 0{\cdot}9523 : 1 : 0{\cdot}9777$. The optical and other properties are described. $3K_2O$, TeO_3, $6MoO_3$, $8H_2O$ forms crystals belonging to the rhombic dipyramidal or holohedral class of the orthorhombic system and showing perfect pseudo-tetragonal symmetry; their density is $3{\cdot}25 \pm 0{\cdot}05$ and hardness 2·5 (Mohs' scale), $a : b : c = 1 : 1 : 1{\cdot}0519$. The homeomorphism of the two types of crystals is discussed. T. H. P.

3109. Lattice Dimensions of Zinc Oxide. G. I. Finch and H. Wilman. *Chem. Soc., J. pp.* 751–754, *June,* 1934.—A revision of the lattice constants of zinc oxide has been carried out by electron diffraction. For the close-packed hexagonal lattice of zinc oxide, a value for the axial ratio $c/a = 1{\cdot}607 \pm 0{\cdot}002$ has been obtained directly from zinc oxide transmission diffraction patterns. Values for the axes, a and c, have been obtained by reference to a superimposed diffraction pattern due to gold, to the structure of which a value of $a = 4{\cdot}0700 \pm 0{\cdot}0006$ Å has been assigned. These values are as follows: $a = 3{\cdot}258 \pm 0{\cdot}005$ Å; $c = 5{\cdot}239 \pm 0{\cdot}005$ Å. Whilst the value for c/a is in good agreement with those obtained by most previous workers, the electron-diffraction values for a and c are appreciably higher than the corresponding X-ray values. It is sugggested that the discrepancy is probably due to differences in the nature of the materials examined by different investigators. [See Abstract 1329 (1934).] AUTHORS.

3110. Structure of $Pd(NH_3)_4Cl_2{\cdot}H_2O$. B. N. Dickinson. *Zeits. f. Krist.* 88. *pp.* 281–297, *July,* 1934. *In English.*—From oscillation and Laue photographs, $Pd(NH_3)_4Cl_2{\cdot}H_2O$ is found to be tetragonal with $a = 10{\cdot}302 \pm 0{\cdot}03$ Å and $c = 4{\cdot}34 \pm 0{\cdot}02$ Å. There are two molecules in the unit cell and the space group is C^2_{4v}, V^7_d, or D^5_{4h}. A structure is based on the latter space-group. It is considered that the corresponding Pt compound has the same structure. J. T.

3111. Structure of TeO_6H_6. B. Gossner and O. Kraus. *Zeits. f. Krist.* 88. *pp.* 298–303, *July,* 1934.—The two modifications of TeO_6H_6

are examined by means of rotation photographs. The first is found to be cubic with $a = 7{\cdot}83$ Å. There are four molecules in the unit cell and the space group is O^5_h. The second is monoclinic with $a = 5{\cdot}54$ Å, $b = 9{\cdot}30$ Å, $c = 9{\cdot}74$ Å, and $\beta = 104° 30'$. The unit cell contains four molecules and the space group is C^5_{2h}. J. T.

3112. Cubic and Hexagonal Silver Iodide. N. H. Kolkmeijer and J. W. A. van Hengel. *Zeits. f. Krist.* 88. *pp.* 317–322, *July*, 1934.—The cubic form is obtained from solution in the presence of an excess of Ag ions, but the hexagonal for an excess of I ions. The densities are 5·68 and 5·69 respectively. The edge-length for cubic AgI is found to be 6·47 Å (compared with 6·49 Å in the *Strukturbericht*). The hexagonal variety (Wurtzite type) has $a = 4{\cdot}58$ Å, $c = 7{\cdot}49$ Å, $c/a = 1{\cdot}63$. F. I. G. R.

3113. Crystal Structure and Magnetic Susceptibility of $Cs_2AgAuCl_6$ and $Cs_2AuAuCl_6$. N. Elliott. *J. Chem. Phys.* 2. *pp.* 419–420, *July*, 1934.—The triple salts $Cs_2AgAuCl_6$ and $Cs_2AuAuCl_6$ have been investigated by means of magnetic susceptibility measurements and X-ray powder photographs in order to obtain information regarding the general nature of these compounds. Both compounds were found to be diamagnetic. X-ray powder-photographic data lead to a cubic structural unit with $a_0 = 5{\cdot}33$ Å for both crystals. The observed intensity values are in general agreement with the perovskite structure. Small discrepancies, however, suggest that the atomic arrangement varies slightly from the ideal perovskite structure. The detailed nature of the distortion was not determined. The bearing of these results on the valence type of the substances is discussed. AUTHOR.

3114. Structure of Chrysene. J. Iball. *Roy. Soc., Proc.* 146. *pp.* 140–153, *Aug.* 1, 1934.—The crystalline structure of chrysene has been determined by a quantitative X-ray analysis. Crystal data: $a = 8{\cdot}34$ Å, $b = 6{\cdot}18$ Å, $c = 25{\cdot}0$ Å, $\beta = 115{\cdot}8°$, space group $C^6_{2h}(I2/c)$ or C^4_s (Ic). Crystal density = 1·27. Four molecules of $C_{18}H_{12}$ per unit cell. The molecule appears to be planar and to consist of regular hexagons, the interatomic distance being 1·41 Å. The orientation has been found by a combination of the "trial and error" method and a double Fourier analysis about the (Okl) zone. The coordinates of each atom are given. AUTHOR.

3115. Growth of Metal Crystals in Metal Vapour. Part III. M. Straumanis. *Zeits. f. phys. Chem.* 26. *Abt.*B. 3. *pp.* 246–254, 1934.—The sublimation of Mg was investigated under different pressures varying from 0·001 mm. and 360 mm. Hg. The determinations formed a test of the theory of homopolar growth of Kossel and Stranski. The sublimation was effected at temperatures below the melting point of Mg. Earlier experiments on the sublimation of Cd were extended by new measurements. Mg crystals were deformed with great ease. The slip changes were exactly as in the case of Zn. [For Part II see Abstract 4786 (1932).] F. J. B.

3116. Vicinal Surfaces of Alum Octahedra during Crystallisation. A. Schubnikow. *Zeits. f. Krist.* 88. *pp.* 336–342, *July*, 1934.—The angle between the vicinal faces changes continuously during growth, depending upon the change in supersaturation of the solution. Concave angles can be formed by such faces which belong to two different "simple forms." The effect is only possible in the presence of cube faces. F. I. G. R.

3117. Alteration of Unit Cell by Stress. F. Lihl. *Phys. Zeits.* 35. *pp.* 460–468, *June* 15, 1934.—Specimens of alloy steel are subjected to tensile stress and examined by the Debye-Scherrer method and the cone reflection method. It is found that the lattice is no longer cubic but has a lower symmetry. The maximum and minimum spacings are independent of the angle between the X-ray beam and the direction of stress, a result which is of importance in the measurement of increase of lattice energy by change in spacing. It is concluded that the term " mean lattice parameter " has no meaning for specimens such as those examined. J. T.

3118. Plastic Deformation of Iron Crystals. N. Akulov and S. Raewsky. *Ann. d. Physik,* 20. 2. *pp.* 113–117, *June,* 1934.—Using a method previously described [see Abstract 1208 (1933)] the paramagnetic powder Fe_2O_3 is scattered on the polished surface of a single crystal of iron. The pattern into which the powder falls is observed while the crystal is compressed beyond the elastic limit. For a small compression a set of parallel lines appears, which changes for larger compressions to a set perpendicular to the first, and finally for yet greater compression, returns to the original direction. Slip lines revealed by etching are at approximately 45° to these lines. A brief discussion follows. J. P. A.

3119. Plastic Deformation of Crystals. G. I. Taylor. *Roy. Soc., Proc.* 145. *pp.* 362–404, *July* 2, 1934.—It is supposed that slipping occurs over limited lengths L of the slip plane, and it is shown that this type of plastic strain necessarily gives rise to elastic stresses near the two dislocations which occur at the two ends of each of these lengths L. It is then shown that the assumption that such dislocations will migrate through the crystal, owing perhaps to temperature agitation, under the influence of even the smallest shear stress leads to a definite picture of the mechanics of plastic distortion. This theory of strain hardening is expressible in quantitative form and gives a parabolic relationship between stress and plastic strain, namely, $S/\mu\sqrt{s} = \kappa\sqrt{\lambda/L}$. This expression is in good agreement with the results of experiment with metals which crystallise in the cubic system. The observed parabolic relationship is then used in connection with the formula to determine L which is found, at room-temperatures, to be of order of magnitude 10^{-4} cm. This is of the same order of magnitude as the observed spacings of faults in metals and rock-salt. According to this theory the part played by the system of faulting or mosaic structure is to limit the free motion of centres of dislocation. The actual strain takes place inside the " blocks " of the mosaic structure and the crystallographic nature of the faults is immaterial from the point of view of the theory. [See following Abstract.] AUTHOR.

3120. Strength of Rock-Salt. G. I. Taylor. *Roy. Soc., Proc.* 145. *pp.* 405–415, *July* 2, 1934.—A recent theory of the strength of metals is applied to rock-salt and shown to lead to a parabolic relationship between tensile stress, P, and plastic strain log (l/l_0) where l is the length of a stretched bar of rock-salt whose initial length is l_0. This relationship is $P/\mu\sqrt{\log (l/l_0)} = 2\sqrt{2}\,\kappa\,\sqrt{\lambda/L}$, where μ is the elastic modulus of rigidity, λ is the atomic spacing along the plane of slip, κ is a constant whose value can be calculated approximately, L is the mean free path of centres of dislocation. For rock-salt good agreement is found, and L is shown to be of order of magnitude 10^{-4} cm. This is the order of magnitude of the distance between faults in the structure of rock-salt. It is concluded that

the strain in rock-salt occurs in the parts where the crystal order is perfect, and that the strength is determined by the mean free path L of the centres of dislocation. L is determined by the distance apart of the faults and by the temperature. The theory therefore assigns a definite function to the faults in determining the strength of crystals irrespective of their actual crystallographic or atomic nature. [See preceding Abstract.]
AUTHOR.

3121. Focussing Methods in Analysis of Crystalline Powders and Spectrography of X- and γ-Rays. H. Hulubei. *Comptes Rendus*, 198. *pp.* 2164–2166, *June* 18, 1934.—The author demonstrates the superiority of his method over the somewhat similar method of Rogozinski and others [see Abstracts 924 and 1818 (1934)]. An improvement in the former is described depending on the use of a crystal plate bent to form part of a cone of revolution.
C. A. S.

3122. Long-Wave X-Rays in Crystal Analysis. H. O'Daniel. *Zeits. f. Krist.* 88. *pp.* 304–316, *July*, 1934.—The X-ray tube and camera used for obtaining photographs with long-wave X-rays are described and examples of their use are given.
J. T.

See also Abstracts **3080, 3081, 3082, 3241, 3243, 3276, 3281, 3290, 3328, 3329, 3343, 3388, 3389, 3390, 3410, 3445.**

DENSITY.

3123. Direct-Reading Volumenometer for Porous Bodies. C. H. Spiers. *Journ. Sci. Instruments*, 11. *pp.* 216–218, *July*, 1934.—The volumenometer has two parts, into one of which the test specimen is introduced, and the volume of the other is adjustable by mercury. The volume of mercury which must be introduced into one part when the specimen is placed in the other, in order to maintain the equality in volume, gives the real volume.
AUTHOR.

See also Abstracts **3136, 3140, 3354, 3359.**

DIFFUSION AND OSMOSIS.

3124. Diffusion Coefficients in Gaseous Systems. E. R. Gilliland. *Indust. and Engin. Chem.* 26. *pp.* 681–685, *June*, 1934.—After a summary of the formulæ resulting from the kinetic theory of diffusion, and of methods of measuring the coefficient of diffusion, the whole of the existing data are represented graphically, including some new experimental determinations for diffusion of the vapours of mercury and a number of organic materials in air. The results may be represented by a semi-empirical relation giving the diffusion coefficient in terms of absolute temperature T, molal volumes at the normal boiling points, (V_A and V_B), molecular weights M_A and M_B, and pressure P in atmospheres, *viz.*, $D = \{0{\cdot}0043T^{\frac{3}{2}}\sqrt{(1/M_A) + (1/M_B)}\} / (V_A^{\frac{1}{3}} + V_B^{\frac{1}{3}})P$. A complete list of references is added.
J. P. A.

3125. Theoretical Treatment of Chemical Reactions in Flowing Systems. T. Förster and K. H. Geib. *Ann. d. Physik*, 20. 3. *pp.* 250–260, *June*, 1934.—The mathematical theory of chemical reactions of the first order between gases flowing into a reaction chamber, the products flowing out therefrom, is developed, account being taken of diffusion.
J. S. G. T.

3126. Membrane Equilibria. A. Ganguli. *Kolloid Zeits.* 67. *pp.* 304–306, *June*, 1934.—A statistical theory of solution is worked out, which gives the free energy per gm. mol. dissolved, both for neutral molecules and for charged ions. From this a general expression is obtained for the pressure difference between two phases on either side of a semi-permeable membrane, and for the osmotic pressure of a solution. J. P. A.

3127. Micromethod of Measuring Osmotic Pressure. E. J. Baldes. *Journ. Sci. Instruments,* 11. *pp.* 223–225, *July,* 1934.—A modified thermal method of measuring vapour-pressure is described, with which osmotic pressures of aqueous solutions can be determined, accurate within a fraction of 1 % on quantities as small as 0·1 mg.

AUTHOR.

See also Abstracts 3088, 3097, 3335, 3392.

ELASTICITY AND PLASTICITY.

3128. Plastico-Viscous Deformation of Soft Metals. W. E. Grimshaw. *Roy. Soc., Phil. Trans.* 233. A724. *pp.* 217–245, *June* 22, 1934.—In tensor notation a theory is developed for the motion of a soft metal cylinder when subjected to a compressive load, directed axially, and sufficient to cause permanent deformation. Surface friction is assumed absent. The metal is taken to be homogeneous, isotropic, and incompressible, and coefficients of plasticity and viscosity are incorporated in the stress-strain relations. The effects of different rates of application of the load are examined; and the theorems of the analysis are shown to agree with the results of experiments performed mainly upon copper cylinders. J. P. A.

3129. Flexural Oscillations in a Thin Rod. K. Wolf. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 3–4. *pp.* 79–86, 1934.—The calculation of the frequency of vibration of a thin rod with rectangular section is carried to a higher degree of approximation, and leads to a frequency differing by some 6 % from that calculated by more usual methods. J. P. A.

3130. Free Vibrations and Buckling Loads of Parabolic Rods. K. Federhofer. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 3–4. *pp.* 131–150, 1934. —A thin beam whose axis is the arc of a parabola has its ends anchored firmly to two points on a horizontal plane, and is loaded throughout its length. By Ritz' method of approximation, the frequencies of fundamental and first overtone are calculated for a range of different parabolic forms, first for the case of extensionless vibrations, and secondly including the effects of extension. Values of the buckling loads are also calculated.

J. P. A.

3131. Propagation of Elastic Waves in Ice. Part II. M. Ewing and A. P. Crary. *Physics,* 5. *pp.* 181–184, *July,* 1934.—A seismograph, used to study propagation of explosion-generated waves in a sheet of ice on a lake, revealed the existence of flexural waves. These waves showed marked dispersion, the group velocity being represented approximately by the empirical formula $U = 221\ (en)^{\frac{1}{2}}$, where e is the thickness of the ice in feet and n is the frequency. A theoretical formula is developed by which the velocity of these waves may be calculated from the elastic constants of ice and water. By a suitable orientation of the seismograph it was possible to detect transverse waves, polarised horizontally, in the sheet of ice. The velocity of transverse waves was found to be 6057 ft./sec. which checks within about three per cent with the value of velocity calculated from the elastic constants of ice as reported in Part I [see Abstract 2738 (1934)]. AUTHORS.

3132. Fracture of Fibred Iron-Silicon Sheets. F. Bitter. *Roy. Soc., Proc.* 145. *pp.* 668–675, *July* 2, 1934.—Experiments are reported on specially prepared iron-silicon sheets which are characterised by a fibre structure, as revealed by X-rays, in which diagonal axes of the crystal grains are disposed symmetrically about two mutually perpendicular directions in the plane of the sheet. Strips cut from such sheets in various directions were broken by tension at the temperature of liquid air and a few degrees above room-temperature. At low temperatures the material is brittle, and there is a tendency for fracture to take place along (100) planes only. At the higher temperatures fracture takes place along a line making a certain angle with the direction along which tension is applied. This angle depends on the orientation of the fibre-structure within the strip. It is shown that the angle of break may be used to estimate the degree of fibring in a rolled sheet. AUTHOR.

3133. Photographic Measurement of Liquid Level in Manometer Tube. A. Fortier. *Comptes Rendus,* 198. *pp.* 2142–2144, *June* 18, 1934.—Assuming the manometer tube to be vertical, a point source of light is placed close to it and below the meniscus so that the ray after refraction into the liquid is totally reflected at the under surface of the meniscus; the caustic by reflection thus produced is photographed by a camera pointing horizontally. C. A. S.

3134. Precise Measurement of Isotherms. J. J. M. van Santen. *K. Onnes. Lab., Leiden, Comm. No.* 227(*a*). *pp.* 1–10, 1934.—The calibration of a closed manometer and the construction of an electric thermostat are described. The cubic expansion coefficient of the glass Jena 2954^{111} was measured. A slightly modified value of the expansion coefficient of mercury was used. The capillary depression and the corrections of the mercury thermometers are discussed. AUTHOR.

3135. Mechanical Testing Machine. R. C. Gale. *Journ. Sci. Instruments,* 11. *pp.* 209–214, *July,* 1934.—A mechanical testing machine is described which is suitable for testing metals or other solid materials by tension, compression, indentation, bending, etc. The test-pieces are held in readily interchangeable shackles and grips attached to the movable members of the machine. Stress is applied to the test-piece by the rotation of a capstan-headed screw, and is balanced and measured by the compression of a stiff helical spring. AUTHOR.

3136. Compression of Highly Dispersed Metal Powders. Part III. W. Trzebiatowski. *Zeits. f. phys. Chem.* 169. *Abt.A.* 1–2. *pp.* 91–102, 1934.—An apparatus was designed in which copper and gold powders could be compressed to pressures up to 15,000 atmospheres. The temperature was varied from 20° to 600° C. Under the high pressures and temperatures solid pieces of metal were formed. The density, hardness, electrical conductivity and structure of the pieces so produced were investigated. The specific electrical resistance, and the temperature coefficient of the pressed metals corresponded to those of the massive metals. [For Parts I and II see Abstracts 460 and 784 (1934).] F. J. B.

See also Abstracts 3119, 3120, 3359.

HYDRODYNAMICS AND AERODYNAMICS.

3137. Mathematical Theory of the Vibrating Wing. W. Schmeidler. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 163–172, *June,* 1934.—A mathematical theory of a vibrating aerofoil, the depth of which varies with time, is developed. J. S. G. T.

3138. Dynamical Theory of Turbulence. G. D. Mattioli. *Accad. Lincei, Atti,* 19. *pp.* 572–577, *April* 22, 1934.—The author's dynamical theory of turbulence [see Abstracts 3329 and 4357 (1933)] had to be left unverified and incomplete for want of experimental data. Now, however, the precise measurements of Nikuradse on the turbulent flow of liquids in pipes have enabled the author definitely to confirm his theory. A. D.

3139. Turbulent Flow. H. Schlichting. *Naturwiss.* 22. *pp.* 376–381, *June* 1, 1934.—Gives a general discussion of the problem of determining the point of onset of turbulent flow and describes experiments to test the results obtained. The author concludes that, in principle, the conditions governing the stability of straight-line flow against the effect of slight disturbances, and hence the conditions for the occurrence of turbulence, are determinable. J. W. T. W.

KINETIC THEORY OF MATTER.

See Abstracts 3083, 3107, 3200.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

3140. Fundamental Standards of Length in Terms of Wave-Lengths of Light. J. E. Sears, Jr., and H. Barrell. *Roy. Soc., Phil. Trans.* 233. *A*723. *pp.* 143–216, *June* 22, 1934.—Determinations of the lengths of the International Prototype Metre and the Imperial Standard Yard in terms of the wave-length of Cd red radiation, both in air and *in vacuo,* have been made at the National Physical Laboratory by methods and apparatus which have been previously described [see Abstract 79 (1933)]. Three previous determinations of the metre, in terms of Cd red radiation in air, have been made by other observers, and the results, after adjustment from the experimental data available to uniform conditions, agree with each other and with the new value now provided, within a total range of 4 parts in 10^7. The paper records the first independent determinations of the relationship between wave-lengths *in vacuo* and the units of length, and incidentally provides a value for the refractive index of dry air, CO_2-free, which differs appreciably from that given by Meggers and Peters, but agrees well with the more recent value given by Pérard. Furthermore, the results provide a new value for the ratio of the yard to the metre which is in good agreement with that obtained by purely metrological methods. By using two Fabry-Perot étalons of different lengths for making the basic measurements in terms of light waves, evidence was obtained that such hyperfine structure and asymmetry as may be present in Cd red radiation have no appreciable effect on practical measurements of length of the type described. From consideration of the reproducibility of the value of the refractive index of different samples of dry air, CO_2-free, it is deduced that the density of air under standard conditions is constant to at least ± 1 part in 10,000. Suggestions are included as to the possibility of eventually defining the units of length in terms of the wave-length of some suitably chosen radiation of visible light instead of, as at present, by reference to material standards of length, and it is stated that the precision of ascertainment of length on such a basis would be at least 5 times greater than that now possible with line-standards. H. B.

3141. Variations of Length of Invar Wires. F. Neumann and H. Johannsen. *Zeits. f. Instrumentenk.* 54. *pp.* 173–190, *June,* 1934. *From the Reichsanstalt.*—It is explained that the subsequent behaviour of properly conditioned and well aged invar Jäderin wires is essentially due to the combination of two effects, namely, the well-known secular increase in length consequent upon structural changes in the alloy, and the changes occasioned by accidental strains in the wires. The paper chiefly deals with the latter, in particular the length changes and strain relations set up by artificially produced kinks in a specimen of invar wire. The geometrical characteristics of these kinks were measured and their effect on the length of the specimen under various tensions was measured in a 1-m. comparator. After a kink is formed the results indicate that the initial shortening of the wire is followed up by a fairly rapid lengthening, if the wire is under tension, which persists until a steady condition is reached. In conclusion recommendations for handling and using invar wires are given which it is anticipated should improve the accuracy obtained in measurements of a base. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3142. General Analytical Representation of a Class of Closed Trajectories in the Plane. G. Grobe. *Zeits. f. Physik,* 89. 5–6. *pp.* 388–394, *June* 2, 1934.—It is shown that types of closed trajectories in the plane can be represented in a rectangular coordinate system so that one coordinate is represented by a cosine function of a variable t whilst the other is represented by Fourier series of the same variable. The theory has applications to the types of curves obtained from hysteresis experiments. G. C. McV.

3143. Mid-Course Method of Fitting a Parabolic Formula of any Order to a Set of Observations. T. Smith. *Phys. Soc., Proc.* 46. *pp.* 560–569; *Disc.,* 569–573, *July* 1, 1934.—A meaning for the closeness of fit of a formula which is considered widely applicable in physics is suggested, and a method of deriving the most closely fitting parabolic formula of a given order is described. Geometrically the formula represents the mid-course between the most outlying points. AUTHOR.

3144. Determination of a Parabolic Formula to Represent a Series of Observations. J. H. Awbery. *Phys. Soc., Proc.* 46. *pp.* 574–581; *Disc.,* 581–582, *July* 1, 1934.—When the constants a, b and c in the formula $y = a + bx + cx^2$ are to be determined from simultaneous values of x and y, the best-known methods involve the addition of a number of equations, which are then solved to give the desired constants. A large number of significant figures must be retained in the calculation. It is pointed out that if one constant can be determined separately from the other two, the arithmetic can be greatly simplified. It is frequently of advantage to determine first the constant c, since this is the constant needed to correct mean values to instantaneous values. It can be easily found by the method of divided differences which, in contrast to the more familiar methods, reduces the number of significant figures to the minimum permissible. If the observations are very irregular, the method in its crudest form gives a very poor estimate of *c*, but a modification is described which adds little to the labour, whilst improving the accuracy very considerably. Numerical examples are given, and the results by the new method are compared with those obtained by the methods of least squares and zero sum. AUTHOR.

3145. Systems of Coordinates Inter-Transformable by the Lorentz Group. J. le Roux. *Comptes Rendus*, 198. *pp.* 1967–1970, *June* 4, 1934.—A theoretical method is developed for finding sets of Lorentz coordinates which leave invariant the same fundamental form as some given set. G. C. McV.

3146. Lorentz Groups, Semi-Vectors and Spinors. J. Ullmo. *J. de Physique et le Radium*, 5. *pp.* 230–240, *June*, 1934.—Mathematical. Sets forth a method whereby, by means of the theory of continuous and finite groups certain properties of the group of Lorentz transformations may be shown to lead naturally to semi-vectors and spinors in addition to the ordinary vectors and tensors. A. D.

3147. Generalisation of Lorentz Transformation. F. Tavani. *Phil. Mag.* 18. *pp.* 187–192, *July*, 1934.—Forms of the Lorentz transformation when the origin describes a curvilinear path under a given law are derived for the cases of motion in two and in three dimensions. J. S. G. T.

See also Abstracts 3125, 3152, 3270.

MECHANICS, CLASSICAL.

3148. Forced Pseudo-Harmonic Vibrations. I. K. Silverman. *Frank. Inst., J.* 217. *pp.* 743–745, *June*, 1934.—The author refers to the solution of this problem obtained by den Hartog [see Abstract 5170 (1933)]. In this paper Hamilton's principle is used to obtain the motion of forced pseudo-harmonic vibrations in the form of a Fourier series. According to this principle the motion of any dynamical system can be expressed by $\delta \int_{t_1}^{t_2} (K-V)\, dt = 0$ where K and V are kinetic and potential energies of the system. The variation of this integral is a problem in the calculus of variations and the condition for the stationary behaviour of the integral is a differential equation known as Euler's equation. The equation so obtained is the ordinary differential equation of motion. The method adopted contains the so-called exact solution of den Hartog for spring characteristics made up of three sections of straight lines. R. S. R.

3149. Differential Corrections for a Trajectory. A. Wertheimer. *Frank. Inst., J.* 217. *pp.* 729–742, *June*, 1934.—Range tables for anti-aircraft gun trajectories are compiled for given initial velocities and standard air-densities, projectile weights, etc. The author works out in detail sets of formulæ whereby the trajectory can be corrected for variations in the standard conditions. These formulæ are adapted to purely numerical working, for which a full scheme is given. A. D.

3150. General Equations of Mechanics and Electromagnetism. J. Loiseau. *Comptes Rendus*, 198. *pp.* 1980–1982, *June* 4, 1934.—It is claimed that a rational system of mechanics implies that the space employed should be of four dimensions and should be Euclidean. **Errata,** *ibid. p.* 2215, *June* 18, 1934. G. C. McV.

See also Abstract 3159.

MECHANICS, QUANTUM.

3151. Molecular Symmetry and the Reduction of the Secular Equation. Part II. A. E. Stearn, C. H. Lindsley and H. Eyring. *J. Chem. Phys.* 2. *pp.* 410–416, *July*, 1934.—Symmetry is used to reduce the secular equation for nine monovalent atoms forming a body-centred cube from an equation of forty-second degree to equations of third degree and lower. Application of the results is then made to calculate approximately the energy of the isolated unit cell for sodium. The vector method recently put forward by van Vleck is shown to be a valuable check on such calculations. [For Part I see Abstract 5172 (1933).] AUTHORS.

3152. Addition Theorem for Spherical Harmonics and its Application to the Spatial Quantisation of Atoms. H. Hönl. *Zeits. f. Physik*, 89. 3–4. *pp.* 244–253, *May* 24, 1934.—The transformation matrix is derived for expressing spherical harmonics in a given coordinate system, in terms of spherical harmonics in a coordinate system rotated in any manner with respect to the first. Group theory is not used explicitly. Physically, the analysis gives the probability that atoms forming one of the $2j + 1$ pencils in a Stern-Gerlach experiment and all having magnetic quantum number m, will, as the result of an abrupt change in the direction of the non-homogeneous magnetic field, acquire the magnetic quantum number m' where m' assumes in turn all integral values from $+j$ to $-j$. W. S. S.

3153. Factor 137/136 in Quantum Mechanics. A. S. Eddington. *Nature*, 133. *p.* 907, *June* 16, 1934.—The hypothesis put forward by W. N. Bond that in experimental determinations of e/m the quantity actually found is $\frac{136}{137}\frac{e}{m}$, is discussed from the theoretical point of view. A system of two indistinguishable electrons, it is argued, must necessarily have 137 degrees of freedom as against the 136 possessed by a system of two distinguishable particles, the extra degree of freedom in the former case being specified by a coordinate whose variation corresponds to the change in probability with time that the electron originally labelled No. 1 is still the same. It is also argued that the difference between two distinguishable and two undistinguishable particles is reflected in the different kinds of space-time associated with the two problems. G. C. McV.

3154. Dirac Equation in Projective Relativity. A. H. Taub, O. Veblen, J. v. Neumann. *Nat. Acad. Sci., Proc.* 20. *pp.* 383–388, *June*, 1934.—The method of projective relativity is shown to lead naturally to a group of linear equations one of which is identified with Dirac's equation for a charged particle. This equation reduces to the usual one in special relativity. The other equations obtained can be identified with the equations for the electron when the field of a dipole is superposed on the field of charge. G. C. McV.

3155. Relativistic Basis of Quantum Theory. Part II. H. T. Flint. *Roy. Soc., Proc.* 145. *pp.* 645–656, *July* 2, 1934.—This is a second contribution under this title [see Abstract 1866 (1934)] and the quantum equations are obtained in a way which throws a new light upon them and fits them into a consistent scheme. The second order equation is derived, not by an operational process, but by using the first order equations as a substitution in the equation of curvature. The result contains all the terms required in matrix mechanics in the description of the electron. It contains also additional terms for which no explanation is offered.

The treatment is a relativistic one and a discussion on the difficulties associated with the form of Dirac's equation is given. AUTHOR.

3156. Modification of Brillouin's Unified Statistics. D. S. Kothari. *Phil. Mag.* 18. *p.* 192, *July*, 1934.—The author points out that the modification of Fermi-Dirac statistics proposed by Lindsay [see Abstract 1242 (1934)] is effectually the replacement of h in the usual formulæ by $a^{1/3}h$. [See Abstract 771 (1932).] J. S. G. T.

See also Abstracts 3385, 3420.

RELATIVITY AND ETHER.

3157. General Field Theory. Auto-Geodetic Lines and World Lines. J. A. Schouten and J. Haantjes. *Zeits. f. Physik,* 89. 5–6. *pp.* 357–369, *June* 2, 1934.—The general field theory treated in previous papers [see Abstract 2232 (1933)] is somewhat simplified by considering the "auto-geodetic" lines in place of the "induced geodetic" lines of the theory as world lines. J. S. G. T.

3158. Universal Field-Theory. K. Novobatzky. *Zeits. f. Physik,* 89. 5–6. *pp.* 373–387, *June* 2, 1934.—A projective five-dimensional unified field theory is developed having as its distinctive feature the assumption of special values for certain components of the projective metrical tensor. Hamiltonian variation is used to obtain the field equations. G. C. McV.

3159. Concept of Time. R. A. Sampson. *Roy. Astron. Soc., M.N.* 94. *pp.* 603–630, *May,* 1934.—Postulating Euclidean space-time, and the energy of a particle $E = c\sqrt{(\Pi\pi^2 + P_1p_1^2 + P_2p_2^2 + P_3p_3^2)}$, where π, p_1, p_2, p_3 are momenta, conjugate to displacements cdt, dq_1, dq_2, dq_3 and the coefficients Π, P_1, P_2, P_3 are functions of the coordinates and include the effect of a gravitational field, the case is discussed of two particles, related by the equation $E + E' = H$. It is shown that an equation $p_1dq_1 + \ldots + \pi cdt + p_1'dq_1' + \ldots + \pi'cdt' - Hd\tau = 0$ obtains identically, also $H = const.$, and that $\pi = mc$ if t does not occur explicitly. Further, the complete solution for two particles in space-time is given, and the results shown to be the same as those of general relativity, if

$$E = mc^2\left(1 - \frac{2C}{c^2}\frac{m'^2u_1}{m + m'}\right)^{\frac{1}{2}}(1 + v^2/c^2)^{\frac{1}{2}},$$

where m, m' are the masses of the two particles, u_1 differs slightly from the reciprocal of the distance between the particles, and v is the local velocity. It is concluded that the curvature of space-time is not an essential.

AUTHOR.

See also Abstracts 3146, 3147, 3154, 3203.

SOLUTION.

3160. Magnetic Study of the Reciprocal Influence of Potassium Iodide and Water in Solutions of the Former. B. Cabrera and H. Fahlenbrach. *Zeits. f. Physik,* 89. 3–4. *pp.* 166–178, *May* 24, 1934.—The variations of the magnetic susceptibility of KI solutions with temperature and concentration have been studied. The form of the susceptibility-temperature curves varies markedly with change of concentration. Owing to depolymerisation of the water molecules as more KI is added, the temperature effect at first diminishes more rapidly than would be the case if it were purely additive, but at higher concentrations, and beginning at the higher temperatures, it increases and the curvature of the curve reverses. Analysis of these results shows the existence of two effects, *viz.*, depolymerisation, which leads to a minimum susceptibility which is independent of temperature and is the greater the higher the concentration, and a hydration effect which increases with rise of temperature and increase of concentration. In nearly saturated solution all the water exists in the form of single molecules. At room-temperature the degree of hydration of the solute is practically zero at all concentrations. The absolute values of the susceptibilities at 20° C. of KI and its aqueous solutions (up to 57 %) are recorded. H. F. G.

3161. Theory of Solutions of Molecules Containing Widely Separated Charges with Special Application to Zwitterions. J. G. Kirkwood. *J. Chem. Phys.* 2. *pp.* 351–361, *July*, 1934.—The electrical contribution to the chemical potential of an ion having an arbitrary charge distribution is calculated with the aid of the Debye-Hückel theory. The calculation is based upon a general solution in polar coordinates of the approximate Debye-Hückel equation, $\Delta\psi - \kappa^2\psi = 0$. In addition, the Born relation between the free energy of solvation of a spherical ion and the dielectric constant of the solvent, is generalised to include ions of arbitrary charge distribution. Application of the theory to a study of the influence of simple electrolytes, and of the dielectric constant of the solvent on the solubilities of the aliphatic amino-acids in alcohol-water mixtures, is discussed. AUTHOR.

3162. Electrolytes in Media of Low Dielectric Constant. R. M. Fuoss and C. A. Kraus. *J. Chem. Phys.* 2. *pp.* 386–388, *July*, 1934.—A conductance function derived by Halpern and Gross [see Abstract 1878 (1934)] is compared with experimental data for what they consider to be the most favourable case: slight dissociation in a solvent of very low dielectric constant, at concentrations near that of the minimum in conductance. Such comparison shows that the functional form required by their equation is not satisfied by the data for tetraisoamylammonium picrate in benzene over the concentration range $1 \times 10^{-6} - 2 \times 10^{-4}N$. It is pointed out that the Bjerrum radius is not of decisive importance in the interpretation of conductance data. AUTHORS.

3163. Theory of Moderate Deviations from van't Hoff's Law. J. J. Coleman and F. E. E. Germann. *J. Chem. Phys.* 2. *pp.* 396–399, *July*, 1934.—A sketch of the application of van der Waals notions to the study of deviations from van't Hoff's law made by A. A. Noyes is given and a modification of the theory is introduced. An osmotic pressure equation is then deduced from a heat of formation equation. The new theory is shown to be, at least formally, in harmony with the old. Both theories result in an equation of the van der Waals type for osmotic pressures. This constitutes an extension of van't Hoff's very useful analogy between dilute solutes and gases. AUTHORS.

3164. Solvation of Nitrocellulose in Acetone-Water Mixtures. G. L. Wilson and F. D. Miles. *Roy. Soc., Phil. Trans.* 233. *pp.* 247–277, *June* 25, 1934.—From acetone-water mixtures too weak to dissolve it, nitrocellulose takes up more solvent than is accounted for by measurements of absorption. This is attributed to a sponge-like structure in the nitrocellulose which absorbs acetone, swells and imbibes mechanically some of the solvent mixture. When the acetone content reaches from 72 to 87 % (according to the specimen of nitrocellulose used) solution occurs. At this point the solvation is at a maximum with 2 molecules of acetone to each nitrate group. In pure acetone solvation is zero. Some viscosity measurements are also described. A. S. C. L.

SURFACE TENSION AND COHESION.

3165. Capillary Index of Vegetable Oils. H. Marcelet. *Comptes Rendus*, 198. *pp.* 2073–2074, *June* 11, 1934.—The capillary index or emulsive power of certain vegetable oils was determined by Dubrisay's method [see Abstract 2666 (1932)]. Refined olive oil has a much lower index than unrefined olive oil. Hydrolysis appears to increase the index. P. H. B.

3166. Linear Deformation of Films of Cellulose Nitrate a Function of Atmospheric Humidity. A. Charriou and (Miss) S. Valette. *Comptes Rendus*, 198. *pp.* 2161–2163, *June* 18, 1934.—Films of cellulose nitrate 0·1–0·15 mm. thick and both bare and coated with emulsion, were subjected to a stretching force of 100 gm./cm.^{2}, in atmospheres of humidity varying from 0 to 100 %, at 18–21°. In all alike increase in linear dimensions varied linearly with the humidity, increasing by approximately 0·01 % for an increase of 1 % in the humidity. C. A. S.

3167. Surface Tension. A. Ferguson. *Roy. Inst., Proc.* 28. 2. *pp.* 195–206, 1934. *Nature*, 133. *pp.* 893–896, *June* 16, 1934.—The paper deals generally with fundamental principles underlying surface tension and goes on to sketch the making of kinematograph records, some of which are reproduced, of the fall of drops of water and of rough marbles, into a liquid. Nearly 2000 photographs per sec. have been taken and it is hoped to increase this rate so as to record the splash of a drop of mercury on a glass plate. P. H. B.

3168. Surface Tension Measurements by the Ripple Method. H. E. Beckett and H. Sheard. *Journ. Sci. Instruments*, 11. *pp.* 214–216, *July*, 1934.—A modification of the ripple method of measuring surface tension is described, in which a stationary wave pattern is formed between two vibrating styles. The pattern is projected by reflection on to a ground glass screen. Measurements of the decrease in the surface tension of tap water caused by contact with a bituminous paint are cited in illustration of the method. AUTHORS.

See also Abstracts 3073, 3085, 3086, 3095, 3096, 3402, 3413.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

3169. Pendulums with Quartz Knife-Edges. O. Meisser. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 252–257, 1934.—The periods of pendulums with quartz knife-edges resting on agate planes were found to be less constant than those of pendulums with steel knife-edges. Quartz is in this connection similar to other brittle materials. The quartz knife-edges after use were found under magnification to have become sawlike. P. H. B.

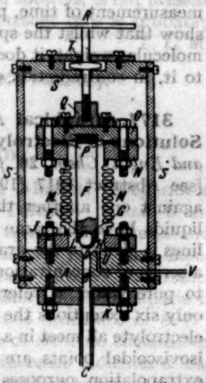
3170. Influence of the Drive on the Period of a Pendulum. H. Schmücking and O. Meisser. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 258–262, 1934.—A mathematical paper. After deriving a relation between the driving force and the logarithmic decrement of a pendulum the correction to the period is determined when impulses are applied at points not near to the middle position. Experimental results will be published later. P. H. B.

3171. Recent Developments in Precision Time-Keeping. G. A. Tomlinson. *Observatory*, 57. *pp.* 189–195, *June*, 1934.—The recent development of accurate frequency standards is summarised, and consideration is given to recent improved forms of pendulum clocks as well as vibration clocks. In discussing the latter, attention is drawn to the vibrating-crystal clock of Scheibe and Adelsberger at the Physikalisch-Technische-Reichsanstalt, to the quartz crystal clock of the late D. W. Dye at the National Physical Laboratory, and to the crystal clock of Loomis and Marrison in New York. These vibration clocks each involve an oscillating quartz crystal. Another form of vibration clock, now being developed by Sears and Tomlinson at the N.P.L., is mentioned. In this clock, the vibrating element is an elinvar bar, 1 m. long, maintained in longitudinal oscillation by electrostatic forces applied at one end. The advantages and limitations of oscillation clocks in general are discussed. The improved form of pendulum clock devised by Schuler at Göttingen is mentioned, and also the new free pendulum clock now being developed and set up by Tomlinson at the N.P.L. J. S. C.

See also Abstract 3159.

VACUA, HIGH.

3172. All-Metal High-Vacuum Valve Without Grease. F. Durau. *Zeits. f. Physik*, 89. 3–4. *pp.* 143–147, *May* 24, 1934.—The construction of the valve is shown diagrammatically in the figure. The tube *c*, which connects with the high-vacuum vessel, has at the end D a hemispherical recess into which the ball H fits accurately, while the tube V connects with the vacuum pump, etc. The valve is sealed from the air by the corrugated cylinder M, which is attached to brass rings N and J by vacuum seals with lead washers L and P. The valve is operated through the handle R, which compresses or extends the cylinder M, and thus permits the ball to be pressed into or withdrawn from the recess. Various uses of the valve are mentioned. G. E. B.



3173. Greaseless High-Vacuum Joints and Seals. F. Durau. *Zeits. f. Physik*, 89. 3–4. *pp.* 148–151, *May* 24, 1934.—Describes in some detail various methods of making vacuum joints by the use of flat surfaces between which lead washers are trapped and pressed tightly. G. E. B.

3174. Applications of Spring Cylinders in High-Vacuum Technique. F. Durau. *Zeits. f. Physik*, 89. 3–4. *pp.* 152–154, *May* 24, 1934.—Discusses various applications of "springy" corrugated cylinders in high-vacuum work. As an example, the cylinder may be fitted with a probe so that by external manipulation a cog-wheel may be turned in a vacuum or a table may be depressed or raised. It is suggested that the method may be used for adjusting crystals *in vacuo* so as to align them with a slit and orientate them with respect to an X-ray beam, etc. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

3175. Law of Viscosity. H. Staudinger. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 434–446, *July*, 1934.—The viscosities of solutions of equal concentration of rod-shaped molecules increase proportionally to the

length of the molecule, *i.e.*, to the molecular weight, and for a 1·4 % solution conform to the expression $\eta = yn$, where y = viscosity of a single chain-atom, and n = number of atoms in the chain. This relationship is only true for hydrocarbons and homopolar oxy-compounds; for heteropolar or nitrogen compounds, the relationship is more complicated. Substitution of rings in such compounds requires a special increment in the expression. Many substances of high molecular weight (*e.g.*, rubber and cellulose) are made up of rod-molecules, whose size (and thence their molecular weight) can thus be deduced from their viscosities. Experiment shows the expression to have a wide range of validity, and it can therefore be used for such molecular weight determinations, and also for investigation of the shape of known molecules in solution. [See following Abstract.]
C. B. A.

3176. Precision Measurements of Viscosities of Higher Hydrocarbons. K. H. Meyer and A. van der Wyk. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 446–448; *Disc.*, 448–451, *July*, 1934.—Measurements of the viscosities of solutions of the normal hydrocarbons C_{17} to C_{30} in CCl_4 solution have been made with special precautions as to temperature, pressure, measurement of time, purity and concentration of materials. The results show that whilst the specific viscosity varies in the same direction as the molecular weight, it does so more rapidly, and is by no means proportional to it, in contradiction of Staudinger's results. [See preceding Abstract.]
C. B. A.

3177. Graphical Analysis of Viscosity-Temperature Data for Solutions of Electrolytes. A. M. Rente and F. E. Seuffert. *Indust. and Engin. Chem.* 26. *pp.* 550–551, *May*, 1934.—It was found by Porter [see Abstract 1017 (1912)] that straight lines are obtained by plotting against one another the respective temperatures at which two organic liquids have the same viscosity (Porter's rule). The name isoviscoidal lines is given to the graphs, and it is shown that the isoviscoidal lines for a series of concentrations of fifteen different electrolytes in water (relative to pure water as reference substance) are all straight. Moreover with only six exceptions the lines for different concentrations of any particular electrolyte all meet in a common point. The coordinates of these so-called isoviscoidal points are tabulated. These data are useful for graphical extrapolation purposes; for the isoviscoidal line for a solution of an electrolyte of a given concentration is determined by a knowledge of the isoviscoidal point and the viscosity of the solution at one other temperature.
L. A. W.

3178. External Friction. B. Derjaguin. *Zeits. f. Physik*, 88. 9–10. *pp.* 661–675, *May* 2, 1934.—A molecular theory of external friction is developed. If the intermolecular attraction forces be neglected and the repulsion forces (rapidly falling off with increasing distances) be replaced by quasi-rigid bonds, having regard also to the thermal oscillations of the molecules, empirical friction-laws are deduced, of which two are those of Amonten and Coulomb. If the cohesion-forces be also taken into account, a generalisation of the first Amonten law is reached, which conforms more closely to experience. The Amonten law referred to is that $dF = \mu dN$, where dF is the element of friction force on a surface-element ds, dN the element of normal reaction on ds, and μ is the coefficient of external friction, independent of the specific pressure $p = dN/ds$. Then $F = \int dF = \int \mu dN = \int \mu p ds$.
A. D.

See also Abstracts 3128, 3335.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

See Abstract 3188.

COMETS AND METEORS.

3179. Luminosity Function of Giacobinid Meteors. F. Watson, Jr. *Harvard Coll. Obs., Bull. No.* 895. *pp.* 9–16, *May* 1, 1934.—Observations of the magnitude of the swarm of October 9, 1933, were made by F. de Roy with the unaided eye and by Sandig and Richter with a small telescope. The observations are reduced and compared and the luminosity function found between apparent magnitudes 0 and 8. Over most of the range there is a linear relation between apparent magnitude and the logarithm of the number of meteors observed. An abrupt change in the slope of the curve, found in the Perseid and Leonid showers, is not present in this case; the distribution of masses in the present case is probably different. T. L. M.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstract 3186.

LATITUDE AND LONGITUDE.

3180. Astronomical Topography at Jan Mayen. Wegener's Question of Continental Displacement. H. Tollner. *Akad. Wiss. Wien, Ber.* 143. *2a.* 3–4. *pp.* 87–97, 1934.—The results of latitude and longitude measurements at Jan Mayen by the Austrian polar year expedition are given and compared with those of 50 years earlier. The observations were at the same point in Wilczektal each time and the comparison shows a latitude difference of $1\cdot6^s$ and a longitude difference of $8\cdot47^s$. Since the latitude difference lies within the limits of error no conclusions regarding change can be made. The longitude difference indicates a displacement westwards of 1270 m. Consideration is given to errors caused by refraction, chronometer rate and personal equation, but these together do not exceed $\pm 1\cdot0^s$. Correction of the ephemerides tables used in 1883 increases the difference to $9\cdot4^s$ or 1400 m. displacement. Errors in telescopic observation in 1883 may amount to 6^s and consequently doubt is expressed regarding the reality of this westerly drift. R. S. R.

NEBULÆ.

3181. Absorption in Space and Colour of Stars in Diffuse Nebulæ. G. Shajn. *Zeits. f. Astrophysik,* 8. *pp.* 168–178, *June* 1, 1934.—The large values of the colour excesses, C.E., of the stars contained in diffuse nebulæ can be explained as being due to selective cosmic absorption; the constant at 1000 parsecs is $+ 0^m\cdot30 \pm 0^m\cdot03$ for these stars. The constant $(\text{C.E.})_n$ due to the surrounding nebula alone is, in the mean, of the order of magnitude $+ 0^m\cdot15$ and for individual stars or individual groups may amount to $+ 0^m\cdot3$ or more. The values $(\text{C.E.})_n$ are greater in the galactic latitude 10° to 24° than in the region 0° to 10°. It is possible that $(C.E.)_n$ is smaller for stars in the diffuse nebulæ with emission spectra than for those in the diffuse nebulæ with continuous spectra.

J. E. K.

3182. Space Distribution of Planetary Nebulæ. B. Vorontsov-Velyaminov. *Zeits. f. Astrophysik*, 8. *pp.* 195–207, *June* 1, 1934.—On the basis of correlations found in a former paper the hypothesis of absolute integrated photographic magnitudes of nebulæ M_n is adopted. The proper motion and radial velocity data together with the galactic rotation lead to $M_n = +0\cdot2$. With this value of M_n the space coordinates and the dimensions of 119 nebulæ were computed. The space density of nebulæ is extremely low and falls rapidly with the increasing distance from the sun. The ring nebulæ show traces of expansion. The absolute magnitude of the nuclei are strongly correlated with their temperature. AUTHOR.

3183. Forbidden Lines of Argon IV in Nebulæ. P. Swings and B. Edlén. *Comptes Rendus*, 198. *pp.* 2071–2073, *June* 11, 1934.—The lines $3s^23p^3$ of A IV can now be estimated from the sequence with PI, S II, Cl III. The predicted wave-lengths $4710\cdot3$, $4738\cdot7$ agree well with lines observed in several nebulæ. Approximate predictions for A III, A V are added. The general resemblance between terrestrial and cosmic distribution of the elements gives the identification of A some importance.

T. L. M.

See also Abstracts 3195, 3196.

PLANETS.

3184. Periodic or Secular Changes of Velocity on Jupiter. A. S. Williams. *Roy. Astron. Soc., M. N.* 94. *pp.* 672–677, *May*, 1934.—The systematic observations of the last half century show that the motion of the S. Temperate Current has been remarkably equable throughout the period, but that there has been a slow but uniform increase in the length of the rotation period amounting to $0^{s}\cdot115$ per annum. There is no definite indication of any periodicity in the velocity of the current. Advantage has been taken of the equable motion to make a fresh and independent estimate of the accuracy with which the rotation period of a current on Jupiter can be determined. The observations of the Southern Current indicate a slow increase in length of rotation period nearly similar to that of the S. Temperate Current. The equable velocities of the surface material of the planet south of lat. 27° is in striking contrast to the considerable and rapid changes occurring in the equatorial regions of the planet. [See Abstract 1494 (1934).] AUTHOR.

3185. Photographic Photometry of the Planet Jupiter and Investigations of the Atmospheres of Jupiter and Saturn. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik*, 8. *pp.* 179–189, *June* 1, 1934.—The results of photometric measurements of photographs of Jupiter are tabulated. The most important conclusions are that the atmosphere of Jupiter is very different from those of Mars and the Earth in that it must have strong absorption and fairly small scattering, that Rayleigh's law of scattering does not hold and that the atmosphere of Jupiter is probably filled with solid particles. J. E. K.

3186. Occultations Observed in 1932. E. W. Brown and D. Brouwer. *Astron. J. No.* 1010. *pp.* 137–152, *June* 4, 1934.—The paper contains the results of the international collection of observations of lunar occultations for 1932. 1199 observations are discussed. Full details are given for those not yet published. For the whole series the correction to the tabular mean longitude is given. Some improvements in the reductions are described. The normal equations for each lunation are now added. The run of the corrections is very similar to that for recent years. T. L. M.

STARS.

3187. System 61 Cygni. G. L. Andrissi. *Accad. Lincei, Atti*, **19**. *pp*. 502–507, *April* 8, 1934.—The author had previously shown that the graph of the known observations was not a straight line, as Flammarion believed, but was a curved line whose curvature has been increasing during recent years. He now computes the orbit by Kowalsky's method and finds the orbit to be hyperbolic; but regards the observations as still too scanty to enable a final conclusion to be reached. If the orbit be periodic, only about one-third of a revolution can have been observed; for the period has been variously computed as 782 years (Peters), 756 years (Baize), 696·63 years (Fletcher). A. D.

3188. Extinction and Effective Wave-Length. V. Oberguggenberger. *Akad. Wiss. Wien, Ber.* **143**. 2*a*. 1–2. *pp*. 31–44, 1934.—The object is to determine the effect of zenith distance on effective wave-length. 13 fields of the zone passing through the zenith have been photographed repeatedly, four of the fields at different zenith distances on each plate. The observational precautions are fully described. The reduction to standard image (0·06 mm.) and to mean temperature (8° C.) is described and tabulated. The result is presented in the form of a set of curves for spectrum types B to M. The correction does not decrease steadily with later types, as anticipated. Most of the curves lie in a fairly narrow band so that an approximate correction can be found at once. But the extinction is not transferable from one instrument and type of plate to another. In this case the mean correction is 46 Å per atmosphere. T. L. M.

3189. Objective Prism Determinations of Effective Wave-Length. P. Rossier. *Arch. des Sciences*, **16**. *pp*. 5–11, *Jan.-Feb.*, 1934. —The use of a prism in place of a grating involves a displacement of the apparent energy maximum towards the red. This is estimated and found nearly independent of spectrum type. If the prism does not intercept all light from the mirror, the interval between the direct image and the spectrum may be employed; or the spectra of two contrary prisms can be utilised. A gain of luminosity and the use of higher dispersions are claimed. T. L. M.

3190. Fluorescence in Hα and Hβ. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* **94**. *pp*. 631–642, *May*, 1934.—The exposure of an atom to dilute temperature radiation leads to cyclic transitions proceeding more frequently in one sense than in the other and the atom fluoresces. This principle of Rosseland is extended to cases of recombination, and applied to three astrophysical problems: the central intensities of Hα and Hβ in the solar spectrum, for which the high intensity is well accounted for; the production of bright lines in stellar spectra in general; and the occurrence of bright reversals. It is suggested that fluorescence is responsible for the central intensities of Fraunhofer lines in general. Light is also thrown on the mottled appearance of the solar disc and on the occurrence of local bright patches. T. L. M.

3191. Total Line and Band Absorption in Stellar Spectra. G. Shajn. *Roy. Astron. Soc., M.N.* 94. *pp.* 642–662, *May,* 1934.—The author has measured the total line and band absorption for ten stars of classes Ao to M5 and discusses its effect on several problems. The observed constancy of the colour index of stars through types from K5 onwards is wholly accounted for. The dependence of colour index within one type on the strength of absorption lines is emphasised. The colour index of extra-galactic nebulæ is also affected. The absorption accounts for some discrepancy in spectrophotometric and spectrobolometric measurements. An apparent luminosity effect is produced especially for M-type variables. The difference between the visual and radiometric amplitudes of such stars is accounted for. An attempt is made to derive the total line and band absorption effect from the radiometric measurements. The connection with limb darkening is also discussed. For the decrease of the total line absorption with increasing wave-length an analogous laboratory effect is brought forward. T. L. M.

3192. Intensities of Interstellar Lines. C. S. Beals. *Roy. Astron. Soc., M.N.* 94. *pp.* 663–672, *May,* 1934.—Measures of the total intensities of interstellar lines in early-type stars in the *h* and χ cluster in Perseus have indicated differences which can scarcely be due to differences in distances of the stars. The most reasonable explanation of these effects seems to be that they are due to blends with stellar Ca. The measures have confirmed the observations of earlier workers that interstellar lines in the Perseus cluster are stronger than those in a corresponding cluster in the Cygnus region. An attempt has been made to interpret the relative intensities of members of the sodium doublet in terms of the atomic mechanism producing the absorption. The results are shown to be consistent with the hypothesis that thermal Doppler effects are the main determining influence on the scattering coefficient for relatively faint lines, but that combined radiation damping and Doppler effects due to galactic rotation probably predominate in lines of greater intensity. The variation of the galactic rotation effect with galactic longitude is suggested as the logical avenue of approach in making further investigations of the problem. [See Abstract 4399 (1933).] AUTHOR.

3193. Neon II Lines in the Spectrum of τ Sco (Bo). H. Kühlborn. *Zeits. f. Astrophysik,* 8. *pp.* 190–194, *June* 1, 1934.—The identification of Ne II lines with lines in the spectra of early B stars which was started by Menzel and Marshall [see Abstract 100 (1934)] is supplemented by the identification of a large number of Ne II lines in the spectrum of τ Sco (Bo). J. E. K.

3194. Comparison of the Continuous Spectra of Several A- and B-Type Stars. D. Barbier, D. Chalonge and E. Vassy. *Comptes Rendus,* 198. *pp.* 2139–2142, *June* 18, 1934.—Spectrograms of α Lyræ, α Virginis, α Leonis and γ Cassiopeiæ are obtained, zenithal distances up to 80° being used and the spectra observed down to 3100 Å. For comparison the continuous spectrum of hydrogen is employed. By means of the spectra of the same star obtained at varying zenithal distances the atmospheric absorption coefficient is determined from 3100 to 4900 Å. The relative intensity curves for the stars studied show, below 3750 Å, the continuous absorption due to atomic hydrogen. A. H.

3195. Stability of Moving Clusters. B. J. Bok. *Harvard Coll. Obs., Circ. No.* 384. [41 *pp.*], 1934.—The dynamics of a moving cluster are studied, with special reference to stability, when the forces on the cluster are: (1) the attraction of the cluster on its members; (2) the tidal forces of the galaxy as a whole; (3) the disrupting effects of chance encounters. It is found that clusters in the neighbourhood of the sun with average density smaller than 0·093 $\odot$/pc.^{3} will probably be unstable. Forces (1) and (2) alone can produce changes in the dimensions of the cluster and a fast moving cluster will not be flattened in its direction of motion. Disruption along the direction toward or away from the galactic centre is predicted for clusters with density equal to the critical density. The Taurus cluster, the Hyades and the Ursæ Major cluster are studied and it may be expected that these clusters will disintegrate within 3×10^9 years whilst the Pleiades will last for 3×10^{10} years. Extended moving clusters are discussed and it is shown that rare spherical moving clusters cannot be expected unless their age is 3×10^8 years or there is no massive nucleus to the galaxy. The analysis presented throws no light on the formation of spiral arms in nebulæ. G. C. McV.

3196. Apparent Clustering of External Galaxies. B. J. Bok. *Harvard Coll. Obs., Bull. No.* 895. *pp.* 1–8, *May* 1, 1934.—A new analysis of the available material regarding the distribution of galaxies is made in order to discover whether or not the observed distribution-curves are consistent with the assumption that these galaxies are, on the average, distributed at random in space. It is found that the bright galaxies of the Shapley-Ames catalogue, as well as those of the Harvard survey, present striking departures from random distribution. The Mount Wilson survey is re-analysed and, when a correction for the dispersion in limiting magnitude of the plates is applied, the distribution curve departs widely from that which would be expected for a random distribution. Thus, contrary to the opinion of Hubble, it is concluded that there is a widespread non-uniformity in the distribution of external galaxies, but that there is as yet insufficient material to indicate the details of this distribution. G. C. McV.

3197. Absorption of Light in Space. P. ten Bruggencate. *Zeits. f. Astrophysik,* 8. *pp.* 157–162, *June* 1, 1934.—A paper by Zug [see Abstract 109 (1934)] is critically examined. It is shown that from the data used by Zug the assumption of an interstellar absorption of light proportional to the distance is not justified. J. E. K.

3198. Spectrum and Orbit of T Aurigae. R. Tremblot. *Comptes Rendus,* 198. *pp.* 1977–1980, *June* 4, 1934.—The photometric measurements of this star carried out in 1931–1932 and in 1934 make it possible to study the smaller component star, whose spectral type is B_1, and to determine the ratio of the masses of the components. This is found to be 1·88. The length of time of eclipse of the smaller component gives a radius of 208 $\odot$ for the larger component (of spectral type K_5). This is the only spectroscopic binary, of spectral type K or M, the ratio of whose masses is known. G. C. McV.

3199. Statistical Investigation of Irregular Variables. G. R. Miczaika. *Zeits. f. Astrophysik,* 8. *pp.* 163–167, *June,* 1934.—Various statistical relations among irregularly variable stars are investigated such as galactic distribution, spectral type, magnitude, and galactic latitude. The main conclusion is that two groups must probably be distinguished among irregular variables which seem to differ principally in magnitude and spectral type. J. E. K.

SUN.

3200. Problem in Kinetic Theory Arising out of a Theory of the Chromosphere. R. L. Rosenberg. *Zeits. f. Astrophysik,* 8. *pp.* 147–156, *June* 1, 1934.—The law of resistance when an atmosphere of neutral atoms is supported by the upward drift of positive ions in this atmosphere, is calculated in kinetic theory. The results are used to discuss the validity of an assumption by Rosseland (*University Observatory, Oslo, Publication No.* 5, 1933) in his theory of the chromosphere. AUTHOR.

3201. Continuous Observation of the Solar Corona. T. Einarsson. *Zeits. f. Astrophysik,* 8. *pp.* 208–224, *June* 1, 1934.—The possibility of continuous observation of the corona outside of eclipse depends on the relative proportion of scattered to coronal light. The scattered light must be less than 100 times that of the corona. On this assumption, all sources of scattered light have been investigated. The various sources of instrumental scattering are fully discussed. Those due to mounting, direct reflection, etc., are obviated by suitable diaphragms. Those due to defects of the objective are tested and the selection of a suitable objective described. With this tests were made on the surroundings of the sun in the yellow and infra-red with different methods of comparison with direct sunlight, and the light of the sky, etc. The results are consistent and appear to show that for the infra-red observation of the inner corona should be possible under good seeing conditions, and that even at low-lying observatories direct detection of prominences should be possible. T. L. M.

3202. Presence of Sulphur in the Sun. Charlotte E. Moore and H. D. Babcock. *Astrophys. J.* 79. *pp.* 492–497, *June,* 1934.—With the aid of new laboratory material on analysis, and unpublished infra-red solar wave-lengths, the spectroscopic evidence of the presence of sulphur in the sun is discussed. Meissner's identifications are revised and extended. 17 S lines are identified in the solar spectrum without question and 6 with some doubt. The observable lines of ionised sulphur have such high excitation potentials that they could not be expected to appear in the sun. The coincidence of a few solar and laboratory wave-lengths is probably due to chance. Tables give the laboratory and solar data on which the results are based. AUTHORS.

3203. Solar Limb Effect. A. Hunter. *Roy. Astron. Soc., M. N.* 94. *pp.* 594–603, *May,* 1934.—The limb effect was studied from two plates obtained in Edinburgh in 1932, each consisting of nine spectra. The mean shifts are tabulated. The different interpretations of this effect are reviewed and it is concluded that none is altogether satisfactory. It is doubtful if the major part of the red displacements is due to the Einstein gravitational effect. The excess shift at the limb and the defect at the centre vary with line intensity and with the epoch. G. C. McV.

See also Abstracts 3189, 3190, 3229, 3298, 3424.

ZODIACAL LIGHT AND GEGENSCHEIN.

See Abstract 3229.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

3204. Location of a Fault by Radioactivity. A. C. Lane and W. R. Bennett. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 353–357, 1934. *In English.*—Radioactivity determinations of the water from seven wells penetrating below the surface glacial deposits in Livingstone County (Michigan) showed three times as great activity in the neighbourhood of what, on other evidence, was believed to be the line of a fault in the subglacial formation, as in water from wells at a distance therefrom. C. A. S.

3205. Seismic Determination of an Inclined Interface of Unknown Dip. F. Gassmann. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 358–363, 1934.—Shots are fired at a series of points along two lines intersecting at right angles at the receiving station, and travel times determined for waves twice reflected at the interface. Then if ϕ be the least angle between either such line and the direction of greatest dip, ϵ the angle of dip, v_1, v_2 the velocities of the direct longitudinal waves in the upper and lower strata, $\sin i = v_1/v_2$, r_1, r_2, r_3, r_4 the ratios of v_1 to the appararent velocities along the four $\perp$ directions, and T the travel time to and from a point on the interface vertically below the station, $\cos i = (r_1 - r_3)/2 \sin\epsilon \cos\phi$, $\tan\phi = (r_4 - r_2)/(r_1 - r_3)$, and the vertical distance from the station to the interface $= v_1 T/2 \cos i \cos\epsilon$. C. A. S.

See also Abstract 3222.

HYDROSPHERE, PHYSICS OF THE.

3206. South Polar Surface Water and its Circulation. H. Thorade. *Naturwiss.* 22. *pp.* 430–434, *June* 22, 1934.—The author refers first to the views of Wüst, Brennecke and Merz regarding the main currents, the distances N. and S. to which the cold Antarctic and Arctic currents penetrate and the depths below the surface at which they are to be found. He then uses the observations of the Meteor and other expeditions on temperature and salt content of the water and of its potential temperature. The cold currents originate in polar basins by increased density due to (1) lowering of temperature, and (2) increased salt percentage due to ice formation. The heavier water sinks and flows equatorwards. The tracks of the Arctic and Antarctic currents are traced into the N. and S. Atlantic and shown on charts. The limits of flow equatorwards are traced and discussed. R. S. R.

LAND, PHYSICS OF THE

3207. Radon Content of Air within the Soil. H. Bender. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 401–415, 1934. *English Abstract.*—The Rn content of the air within the soil was investigated at different depths (25 cm. to 150 cm.) beneath lawn-covered ground at Innsbruck (Tyrol). From the end of Nov., 1932, to the end of May, 1933, the average content of Rn was at a depth of 25 to 50 cm. 8×10^{-14}, in 100 cm. 54×10^{-14}, in 150 cm. 35×10^{-14} curie/cm³. The figures are in good agreement with the results of other observers. The Rn content is varying within very wide limits, the variations being greater in smaller depths. All processes which are apt to clog the soil-capillaries tend to increase the Rn content, for instance freezing, large water content and snow. The maximum amount occurs in winter (Feb. and first part of March) and does not coincide with the time of the temperature minimum. The variations do not take place simultaneously in different depths. Rising barometric pressure increases the amount, while decreasing pressure reduces it. The smallest content was found when the soil was very dry. The amount of Th products (ThB, ThC, etc.) in the samples did not exceed a few per cent of the total activity measured in each case. AUTHOR.

See also Abstract 3180.

METEOROLOGY.

3208. Russian Studies of Stratosphere. *Nature,* 133. *pp.* 918–919, *June* 16, 1934.—This note refers to articles (in Russian) dealing with observations, mainly on cosmic radiation and on samples of air taken at various heights, during the ascent on September 30, 1933. The intensity of the cosmic radiation observed between 9600 and 15,900 m. and the hardness of the rays between 17,500 and 17,900 m. are compared with corresponding values obtained by other observers. Samples of air taken in the stratosphere show no hydrogen, while the percentages by volume of the other gases present correspond very closely to the values for these gases near the surface. The lowest temperature recorded was − 57° C. The pamphlet also describes various pieces of apparatus used. A. E. M. G.

3209. Distribution of Atmospheric Ozone as a Function of Height. D. Barbier. *J. de Physique et le Radium,* 5. *pp.* 243–252, *June,* 1934.—Theoretical considerations on the integral equation which leads to Fabry and Buisson's method [see Abstract 1936 (1934)] show that it is possible to represent the observations relating to ozone distribution by a Charlier series of type A. Generally the total amount of ozone, its mean height and the thickness and mean height of the representative layer can be found and exceptionally, also the standard deviation of this distribution. The study of surface data indicates an asymmetrical distribution. A method is given for the solving of the equation relating to Cabannes and Dufay's method. Diffusion by the atmosphere to very great heights plays the main part at great zenithal distances. The measurements can be interpreted with the help of a thin layer at a height of 40–50 km., but, at least theoretically, this is not the mean height of the distribution. It is of interest to find directly the mass of air traversed by each sample of ozone. It is concluded that these methods alone cannot give with sufficient exactness the distribution of ozone as a function of height and the problem might be solved by combining Fabry and Buissons's results with samples of air obtained simultaneously at heights up to about 15 km. R. S. R.

3210. Atmospheric Ozone and Meteorology. G. M. B. Dobson and A. R. Meetham. *Roy. Meteorolog. Soc., J.* 60. *pp.* 265–278, *July,* 1934.—After referring to the distribution of ozone in the atmosphere and its effect on solar radiation, the authors discuss the three methods of its measurements, photographic, photoelectric and visual. The measurements indicate that ozone exists throughout the whole atmosphere up to 40 km. with a maximum amount between 25 and 30 km. The total amount varies with the season, showing a maximum in the local spring

and a minimum in the local autumn. Marked daily variations occur in Europe with varying meteorological conditions, *e.g.*, maximum amounts being generally observed with cyclones and the reverse with anticyclones. In discussing the origin of ozone the authors point out that no definite conclusions have yet been established though both solar radiation and corpuscular radiation from the sun have been considered as possible sources. Three different theories have also been advanced to account for the variation of ozone content with varying meteorological conditions. With regard to the warm upper layer it is now evident that ozone is not the sole cause but that oxygen must play a very considerable part, particularly at great heights. Further, the authors consider that if daily measurements of ozone could be made at a number of stations, the information so obtained might prove of considerable help in weather forecasting.
A. E. M. G.

3211. Vertical Distribution of Ozone in the Atmosphere. F. W. P. Götz, A. R. Meetham and G. M. B. Dobson. *Roy. Soc., Proc.* 145. *pp.* 416–446, *July* 2, 1934.—A method is described for finding the average height of the ozone in the atmosphere and the general character of its vertical distribution. This method uses spectroscopic observations of the light from the zenith blue sky while the sun is rising or setting. A year's observations have been made at Arosa and the height and distribution of the ozone have been found for the different seasons of the year, and under various meteorological conditions. It is shown that the average height of the ozone in Switzlerand is about 22 km. above sea-level and that the ozone is distributed mainly between the ground and 35 km. The form of the vertical distribution appears to depend chiefly on the total amount of ozone present.
AUTHORS.

3212. Meteorology of India. J. H. Field. *Roy. Soc. Arts, J.* 82. *pp.* 784–799; *Disc.*, 799–806, *June* 15, 1934.—The possibility of using seismograph records as an aid to forecasting is first referred to. Thereafter the author gives an account of the development of upper air investigation in India, which proceeded along two main lines, (*a*) the exploration of the wind currents in preparation for aviation, (*b*) the exploration to all heights by instruments, of the air as regards temperature, pressure and humidity, in the interests of science generally. The work done under section (*a*) reveals the effects arising from the position and magnitude of the mountain ranges. The effects of turbulence in these regions are compared with those experienced near the rock of Gibraltar. The possibilities of motorless gliding are emphasised. The investigations carried out under section (*b*) revealed the position of the tropopause and the variation of temperature with height inside the stratosphere over India. The discussion which follows centres mainly round (*a*) the question of the heights to which sounding balloons are supposed to have reached over India, (*b*) the effect the great Tibetan Plateau is likely to have on the circulation of the atmosphere, and (*c*) how the analysis of air for day to day frontal forecasting is possible, and to what extent present knowledge is useful for that purpose.
A. E. M. G.

3213. Possibility of Condensation by Descent of Air. D. Brunt. *Roy. Meteorolog. Soc., J.* 60. *pp.* 279–284; *Disc.*, 284, *July*, 1934.—The author deals first with iridescent clouds in the stratosphere and their possible mode of formation. From a discussion of the temperature conditions in that region a downward displacement of air may result in condensation provided that a high vapour content exists in levels above

25 km. The idea that the clouds should be formed by air forced up by convection from the troposphere is shown to be untenable, and that saturation at 25 km. can only be explained by the descent of damp air from above. If these clouds are to be explained by the condensation of water vapour, then, as the author points out, it is necessary to assume that water vapour forms a fraction of the total content of the atmosphere which increases with height. The condition that saturated air should produce condensation when expanded or compressed adiabatically is next discussed. As a result it is seen that water vapour is unique in its behaviour, and that much in meteorology depends on this unique behaviour. Entropy-temperature diagrams illustrate the behaviour of representative liquids. A. E. M. G.

3214. Statistical Probability of Rain in London. D. Dewar. *Roy. Meteorolog. Soc., J.* 60. *pp.* 285–310; *Disc.*, 310–312, *July*, 1934.—Dealing with rainfall at Kew for the 50-year period (1872–1921) the day is divided into 4 equal periods commencing at 1 a.m., the rain into 4 types, heavy (A, ·04 in. or more), moderate (B, ·02 or ·03 in.), slight (C, ·01 in.), no rain (D, less than ·01 in.), amounts referring to the 6-hour intervals. Tables are given showing (*a*) the number of times on each day in each month in the 50-year period on which A, B, C, D occur in the 6-hour intervals, (*b*) the totals and frequencies for 10-day periods of rainfall of different amounts. The author finds that "heavy" rain is more frequent in the afternoon than at other periods of the day and, in the summer months, least in the early morning. For B and C rain, B is more likely during daylight while C is more likely during afternoon or night. Smoothed values of rain A and D are tabulated for 10-day periods and comparison curves indicate that no-rain graphs are similar to inverted graphs of heavy rain. From the graphs of all the different types it is shown that the afternoon period has the lowest frequency of rain throughout the year, the night and early morning being the driest period. Comparison is also made with the frequency of rain in Paris. A. E. M. G.

3215. Altitude Distribution of Clouds. P. Barreca. *Arch. des Sciences*, 16. *pp.* 12–16, *Jan.–Feb.*, 1934.—The author tabulates the frequency of clouds for altitude intervals of 200 m. from the data collected by L. Teisserenc. The curve shows a definite maximum at 1300 m., rapid fall to about 3 km., thereafter fluctuations, but a marked decline around 10km. T. L. M.

3216. Physical Process of Cloud Formation. C. K. M. Douglas. *Roy. Meteorolog. Soc., J.* 60. *pp.* 333–341, *July*, 1934.—The present discussion of these processes turns upon the examples of clouds in the International Cloud Atlas. The study of the physics of the clouds is dealt with by the author under two heads, (*a*) the cloud particles, and (*b*) the physical and dynamical processes leading to condensation. Under the first heading consideration is given to the type of the particle, water drop or ice crystal, and its distribution in different cloud forms. The processes dealt with under the second section are (1) the slow upward motion of air over a large area, (2) smaller air masses rising through their environment, (3) turbulent motion causing irregular clouds or clouds arranged in definite layers, (4) processes causing lenticular clouds indicating local ascent of a damp stratified layer. All these processes are considered in detail and examples cited. A word of warning is given with reference to the interpretation of cloud photographs taken from above as having the same meaning as those taken from the ground. The author considers that "the best method of advancing our knowledge of the dynamical processes associated with clouds is by photographs from below and above combined with aerological observations." A. E. M. G.

3217. Energy in Description of Meteorological Cycles. G. T. Walker. *Roy. Meteorolog. Soc., J.* 60. *pp.* 353–355, *July*, 1934.—If a saturation adiabatic line cuts the tephigram, the area enclosed represents the energy which 1 kg. of dry air loaded to saturation will develop automatically. In connection with this proposition an arbitrary closed path on the tephigram is discussed and the work yielded by the forces of translation on a small mass of air is seen to equal the area on the tephigram, reckoned positive on the clockwise direction. The same result may be obtained from considering the energy involved in the cycle. It is further seen that in all cases at least qualitative information can be got from areas in a tephigram. The cycle by Sandström where air is heated, rises, and then falls, is considered. The analysis of this cycle as commonly given, the author is unable to accept, the reasons for which he states. A. E. M. G.

3218. Shape and Position of Coloured Fringes Surrounding the Earth. P. Barreca. *Arch. des Sciences,* 16. *pp.* 17–34, *Jan.–Feb.,* 1934.—The author regards the observed coloration of clouds as due to diffraction fringes, of the form of surfaces of revolution about the line sun–earth. Observations of the colours of clouds at different altitudes and for different positions of the sun in the sky are used to investigate the shape of these surfaces. They appear to resemble flat paraboloids turned away from the sun and meeting the surface of the earth, but not in a common curve. T. L. M.

3219. Spectrum of the Night Sky, 5000 to 8000 Å. J. Cabannes. *Comptes Rendus,* 198. *pp.* 2132–2135, *June* 18, 1934.—The author extends a previous table of wave-lengths [see Abstract 1527 (1934)] by measurements of panchromatic plates exposed for 6½ hours at Montpellier; 70 wave-lengths are tabulated. Comparison is made with the results of Sommer. The spectrum resembles that of auroræ more in this region than from 3900 to 5000 Å. The excitation potential of the night sky is probably between 13·5 and 19·6 volts. The telluric bands of H_2O and of O_2 are present. Continuous emission of interplanetary origin is negligible in comparison with the discontinuous atmospheric spectrum. T. L. M.

3220. Hygrometry. H. Ebert. *Die Physik,* 2. 3. *pp.* 123–126, 1934.—A Bibliography with comments on the various aspects of hygrometry including: (1) Hygrometric measurements at high temperatures; (2) Theoretical conditions and practical modern methods; (3) Uses in physics, technology and meteorology; and (4) Humidification apparatus. The survey covers the publications on the subject from the year 1930 to 1933. Its contents correspond to the material in the report of Part III of "Heat" Section 9 on Hygrometry of the *Physikalische Berichte.* S. G. B.

See also Abstract 3227.

SEISMOLOGY.

3221. Deep Earthquake Foci. S. W. Visser and V. Conrad. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 484–486, *and pp.* 487–488, 1934. *First part in English.*—Visser refers to the results obtained by Conrad when adopting Turner's results in a study of periods in very deep earthquake foci [see Abstract 133 (1934).] He considers that errors exceeding 200 km. and up to 1300 km. appear in the list of epicentra for the Dutch East Indian Archipelago. For almost half the cases mentioned the differences are intercomparable with the depth and the calculation of depth serves only as a means to correct the errors of the localisation. He concludes that only a special group of earthquakes shows the same characteristics as *Preangerbeben* or West Java earthquakes investigated by Conrad. Conrad in reply states that this source of error was not overlooked and, on account of the errors, depths must be decreased several per cent, but he concludes that the errors are smaller than Visser states. R. S. R.

3222. Energy of Mintrop Waves. W. C. Salm. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 364–372, 1934.—Two general formulæ for calculating the energy and vertical displacement at a given point due to Mintrop waves are worked out. These are then applied to the case of a horizontal surface layer 500 m. thick in which the velocities of the longitudinal and transverse waves are respectively 3500 and 2000 m./sec., lying on a horizontal granite layer in which these velocities are 5900 and 3400 m./sec. The energies and displacements are calculated for points at distances $(320 + 250\,n)$ m. where $(n = 0\text{–}10)$ from the origin of disturbance. The ratios of the results by the two methods vary from 3·25 to 2; it is assumed that the correct values lie between the two. C. A. S.

3223. Records of Distant Vibrations with Short Period Seismometers. G. Krumbach. *Beitr. z. angew. Geophys.* 4. 3. *pp.* 263–268, 1934.—Pronounced near vibration instruments such as those with a true period of 1–3 sec. and large magnification are relatively little used at seismometer stations and comparative measurements with the normal station instruments are seldom possible. The author describes the use of the 15,000-kg. seismometer at Jena for short period vibrations with the Jamalpur earthquake of January 15th, 1934, and shows that good records are obtainable. It is thus possible by using mechanical and optical registration to obtain a universal instrument. R. S. R.

3224. Long-Period Vertical Seismograph. L. J. B. Lacoste, Jr. *Physics,* 5. *pp.* 178–180, *July,* 1934.—A single-spring vertical-motion seismograph of theoretically infinite period is described. Actual periods of over a minute have been obtained with a seismograph of this type while for a period of 37 seconds the period was found to be constant to within 1 second for a variation of 9° in the angle between the seismograph arm and the horizontal. A special type of spring is required. The method of winding such a spring is described. A possible method of temperature compensation is given. AUTHOR.

See also Abstract 3131.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3225. Thunderstorms. Part I. H. Noto. *Phys. Math. Soc. Japan, Proc.* 16. *pp.* 177–199, *May,* 1934.—This paper deals with observations in Aug. and Sept., 1933, on the number and character of lightning discharges in thunderstorms. The atmospherics heard, the number of fluctuations observed in a discharge, the length of the track and the distance of the storm are all discussed in detail. The minute structure of the discharge is examined by means of the change in aerial-earth current recorded by an oscillograph. Results so found are compared with similar results obtained by other observers with a revolving mirror method. Numerical results are given in tabular form throughout the paper. A. E. M. G.

3226. Combination Coefficients for Large Ions and for Uncharged Particles at any Pressure. W. R. Harper. *Phil. Mag.* 18. *pp.* 97–113, *July*, 1934.—By extending a previous theory of the author [see Abstract 3413 (1932)] a formula is derived for the frequency of approach to within a distance σ of particles suffering random Brownian displacements, the formula being valid for all values of σ/λ where λ is the mean free path. A further extension generalises the effect of mutual electrostatic attraction on this frequency to nearly all values of σ/λ. This enables the recombination coefficients for large ions to be calculated, different formulæ being obtained for different values of the radius of the ion and different pressures. The recombination of multiply-charged large ions is shown to be peculiar. The combination coefficients for small ions with uncharged nuclei are calculated, and the relation between them and the recombination coefficients shown to be different from that announced recently by Whipple [see Abstract 2910 (1933).] The results for atmospheric pressure are exhibited graphically and compared with the available experimental data. Finally, it is shown how, from observations on large ions, the mass of a clustered small ion could be found without making any assumptions about the size or structure of the cluster. AUTHOR.

3227. British Polar Year Expedition to Fort Rae, N.W. Canada, 1932–1933. J. M. Stagg. *Roy. Meteorolog. Soc., J.* 60. *pp.* 253–263, *July*, 1934. *See also Roy. Inst., Proc.* 28. 2. *pp.* 328–336, 1934.—After referring to the work carried out during the First Polar Year 1882–83, the author outlines the principles on which the programme for 1932–33 was based, and in particular the part played by Great Britain in that programme. The section of this work at Fort Rae in Canada was carried out by a staff of six under the direction of the author. The method of installation of the various instruments used is described and likewise the precautions taken to ensure continuous and reliable readings. The four main branches of investigation were, terrestrial magnetism, aerological work where both pilot balloons and ballons-sondes were used, atmospheric electricity and photography of the aurora. For the last set a base 15 m. long was used and about 4700 pairs of photographs obtained. The work covered 13 months from 1st August, 1932, to early September, 1933. A. E. M. G.

3228. Recording the Electric Space-Charge of the Air. C. W. Lutz. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 416–428, 1934.—A description is given of the method of obtaining a continuous record of the space-charge in air with the cage apparatus of W. Thomson. The voltage from a probe giving off a stream of ions (or water drops) at the middle of the cage is measured by a string electrometer and recorded by a spot of light on a moving film. This potential is subject to errors due to contact potential (volta-effect) between the metal parts arising from humidity, oxidation and dust, and also to potential disturbances from the apparatus itself. These can be reduced to a minimum, however, if the experiment is carried out in an apparatus made from seasoned copper. H. M. B.

3229. Auroræ and Cosmic Rays. A. Dauvillier. *Soc. Franç. Élect., Bull.* 4. *pp.* 383–404, *April*, 1934. *Electrician*, 112. *pp.* 787–789, *June* 8, 1934. *Abstract.*—The author gives a connected account of his theory regarding the origin of the aurora, cosmic rays, zodiacal light and terrestrial magnetic phenomena, with a statement of his observations at Scoresby Sound supporting the same. [See Abstracts 187 (1932), 5231 (1933), 545 and 568 (1934).] C. A. S.

See also Abstract 3407.

RADIOACTIVITY.

3230. Energies of α-, β- and γ-Rays. H. A. Wilson. *Roy. Soc., Proc.* 145. *pp.* 447–461, *July* 2, 1934.—Reasons are given for believing that all low energy α- and β-rays are emitted by the electronic system after it has been excited by a γ-ray from the nucleus. The higher energy β- and γ-ray energies are compared with the theory, previously suggested, that the nuclei of all the radioactive atoms emit rays with energies which are equal to multiples of $3 \cdot 85 \times 10^5$ electron volts. The disintegration energies are also considered on this theory. It is concluded that there is a considerable body of evidence which appears to support the theory. AUTHOR.

3231. Radio-Elements Produced by Neutron Bombardment. Irène Curie, F. Joliot, P. Preiswerk. *Comptes Rendus*, 198. *pp.* 2089–2091, *June* 11, 1934.—The authors have repeated and confirm certain of Fermi's experiments. It is noted, however, that in the case of P, in addition to the element observed by Fermi to have a half-period of about 3 hr., there is another having a period of 2–3 min. This value for the half-period, together with certain other considerations suggests that the decaying element is $^{28}_{13}$Al, an element which is also produced by neutron bombardment of Si and α-particle bombardment of Mg. J. E. R. C.

3232. Possible Production of Elements of Atomic Number Higher than 92. E. Fermi. *Nature*, 133. *pp.* 898–899, *June* 16, 1934. —All the elements which become active on bombardment with neutrons are found to emit β-particles, the neutron probably being transformed into a proton. Chemical separation of the β-active element is then performed and the activity checked with a Geiger-Müller counter. With Al, Cl and Co the active element obtained has atomic number Z-2 where Z refers to the parent element; with P, S, Fe and Zn the atomic number of the active product is Z-1, while with Br and I the active element is an isotope of the parent element. Three main processes are possible, (*a*) capture of a neutron with instantaneous emission of an α-particle, (*b*) capture with emission of a proton, (*c*) capture with emission of a γ-ray quantum to remove the surplus energy. Both Th and U are strongly activated by neutron bombardment. A rough survey of the Th activity showed the existence of at least two periods. With U periods of 10 sec., 40 sec., 13 min., plus at least two more periods of from 40 min. to 1 day were established. The β-active element with the 13 min. period could not be chemically separated with any of the elements near U in the periodic table and it is suggested that the atomic number of the element may be greater than 92. Evidence is given for believing that it is chemically homologous with Mn and Rh which would give it an atomic number 93 but the possibility of an even higher atomic number is considered. F. C. C.

3233. Quantitative Study of Pleochroic Haloes. Part I. G. H. Henderson and S. Bateson. *Roy. Soc., Proc.* 145. *pp.* 563–581, *July* 2, 1934.–A recording photometer has been constructed for the purpose of measuring the amount of darkening in pleochroic haloes. Typical records of uranium haloes in biotite are given. They show features in good numerical agreement with α-ray ranges, all the α-particles from the uranium family being accounted for. A theory of the formation of these haloes is proposed and found to be in general agreement with the photometer records. The method serves to detect the presence of actinium along with the uranium and seems promising for the detection of possible α-ray groups of hitherto unknown ranges. AUTHORS.

3234. Quantitative Study of Pleochroic Haloes. Part II. G. H. Henderson and L. G. Turnbull. *Roy. Soc., Proc.* 145. *pp.* 582–591, *July* 2, 1934.—A study of a biotite from Renfrew, Ontario, was made by the halo photometer. The ring radii were found to be in satisfactory agreement with the known ranges of the α-particles of the uranium and actinium families. In addition two small rings were found having radii corresponding to α-particles of range 1·74 and 1·05 cm. respectively. It is pointed out that there is no evidence of any change in the ranges of the α-particles in the course of geological time. The Renfrew haloes yielded some very striking photometer records, on which could be seen an effect analogous to the Eberhard effect in photography. A discussion is given of the shape of the photometer curves and their possible explanation. AUTHORS.

3235. Method of Determining the Age of Certain Minerals. G. H. Henderson. *Roy. Soc., Proc.* 145. *pp.* 591–598, *July* 2, 1934.—The effect of the actinium series in pleochroic haloes of the uranium type is discussed and shown to lead to a new method of finding the ages of the mineral bearing the haloes. Application of the method is made to three biotites which have been studied in detail. AUTHOR.

3236. Extraction of RaD and Polonium. T. Bjerge. *Zeits. f. Physik,* 89. 5–6. *pp.* 277–282, *June* 2, 1934.—The most usual sources of RaD and Po, for experimental purposes are the emanation tubes used in therapy. A new method of dissolving the active salts, using HF and KNO_3 is described; high yields of active solution are obtained. The Po and RaD are separated by electrolytic methods. Ionisation methods of measuring the resulting preparations are discussed. J. E. R.

3237. Excitation of Nuclear γ-Rays. Elizabeth Kara-Michailova. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 1–2. *pp.* 1–9, 1934.—A large number of elements were subjected to α-particle bombardment and of these γ-radiation is definitely excited from the following; Be, B, N, Al, Na, Mg. Special attention is directed to Be which is examined under good geometrical conditions, the results obtained agreeing with those obtained by other authors. Results obtained from the use of paraffin wax and lead as absorbents suggest that the neutrons excite a secondary hard radiation from the latter. J. E. R. C.

3238. Hydraulic Counter for Ionising Radiations. H. Greinacher. *Helv. Phys. Acta,* 7. 3. *pp.* 360–367, 1934. *In German.*—The hydraulic counter consists of a fine horizontal water jet which impinges on a rubber membrane. At a distance of 1 to 2 mm. from the nozzle of the jet is fixed a steel needle and this is connected through a high resistance of 10^8 ohms to a potential of about 2000 volts. When an ionising particle passes through the air in the region between the needle and the jet a loud sound is produced without any form of amplification being required. The conditions of the experiment were varied until the optimum effect was obtained. In addition to the method of acoustical registration purely mechanical or optical methods can be used to register the passage of α-, β-, or γ-rays. An indirect method in which the light incident upon a photoelectric cell is modulated by the water jet is demonstrated. F. C. C.

See also Abstracts **3204, 3207, 3352, 3364, 3365, 3427.**

RADIATION.

ABSORPTION AND TRANSMISSION.

3239. Definitely Directed, Feeble Secondary Valency Forces as True Colour-Carriers. R. Reinicke. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 159–186, 1934.—The theories of colour-formation in organic compounds are discussed, and arguments are advanced in favour of the view that the true carrier of colour is the particular form of tetrahedron chain-arrangement of the benzene ring, analogous to the structure of graphite. The spheres of action of the C, N and O atoms are regarded, not as spheres, but as tetrahedra, the principal and weak secondary valency forces acting along certain definite directions, derived from the crystal structure. The application of these considerations to the various classes of dyestuffs is discussed. T. H. P.

3240. Absorption of Ultra-Violet and Visible Light by Water. L. H. Dawson and E. O. Hulburt. *J.O.S.A.* 24. *pp.* 175–177, *July*, 1934.—The absorption coefficient of chemically pure, fairly dust free water was measured by photographic photometry by using tubes of water up to 272 cm. long. γ, defined by $i = i_0 e^{-\gamma x}$, where x is in cm., was 0·8, 1·9, 4·3, 7·7, 13·5 and 80 × 10^{-3} at wave-lengths 4000, 3600, 3200, 2800, 2400 and 2000 Å respectively. The values were more than 10 times those calculated from molecular scattering. For the visible wave-lengths 5400, 5890, 6700 and 6900 Å γ was 0·0004, 0·0014, 0·0034 and 0·0039, in good agreement with the measurements of Aufsess. For wave-lengths from 4000 to 5400 Å γ was less than 0·0004 and was too small to be measured with the length of tubes used. AUTHORS.

3241. Photoelectric Measurements of the Absorption of Fused and Crystalline Quartz Between 1633 and 1463 Å. W. M. Powell, Jr. *Phys. Rev.* 46. *pp.* 43–46, *July* 1, 1934.—The transmission of eight sections of one specimen of crystalline quartz, eleven sections of another crystal, and six sections of a piece of fused quartz from the General Electric Company was determined between 1633 and 1463 Å. The method is the same as that used for fluorite, except that the photoelectric currents are measured by an FP-54 Pliotron with a galvanometer in the plate circuit. The fused quartz and the first crystal showed large variations in the coefficient of absorption. The other crystal was much more homogeneous, and from it the percentage of light removed at the surfaces was determined. The extraordinary variations in the coefficient of absorption show the importance of actually testing a piece of quartz in the ultra-violet before incorporating it in an instrument for use in that region. AUTHOR.

See also Abstracts 3105, 3261, 3263.

COLORIMETRY.

See Abstract 3320.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3242. Paramagnetic Rotatory Power of Dysprosium Ethyl Sulphate at Very Low Temperatures. Paramagnetic Saturation. J. Becquerel, W. J. de Haas and J. van den Handel. *Comptes Rendus*, 198. *pp.* 1849–1851, *May* 23, 1934.—The rotatory power of

$Dy(C_2H_5)_3(SO_4)_3.\ 9H_2O$ at 1·620° and 4·213° Abs. has been determined in the direction of the optic axis, an approximate correction being made for the magnetic interaction of the ions and the demagnetising field. The results show the simultaneous existence of a paramagnetism which is a function of field strength/temperature and of another type which is independent of the temperature. Complete paramagnetic saturation has been observed, for the first time, at high field-strengths. H. F. G.

3243. Paramagnetic Rotatory Power of Siderite. J. Becquerel, W. J. de Haas, and J. van den Handel. *Comptes Rendus,* 198. *pp.* 1987–1989, *June* 4, 1934.—All the uniaxial crystals so far examined show, at the temperature of liquid helium, two simultaneous paramagnetic effects. One of these is a function of the absolute temperature T and tends to saturation as the field H increases or T decreases; the other is proportional to H and independent of T. The behaviour of siderite is quite different. (1) At the temperature of liquid helium, Lostwithiel siderite exhibits only the effect which is independent of T, and the small negative rotation is proportional to H. At the temperature of liquid hydrogen, the rotation increases rapidly with T; at that of liquid nitrogen, on the contrary, it decreases with T, and continues to do so up to ordinary temperatures. At 14–20° K. the rotation increases more rapidly than H; at the temperature of liquid nitrogen, there is strict proportionality. (2) The variation with temperature of the rotation of Allevard siderite follows the same general course, but with quite different values. The proportionality between rotation and field becomes more exact as the temperature rises. No explanation of these phenomena has been found. C. B. A.

3244. Paramagnetic Rotation of Tysonite. J. H. van Vleck and M. H. Hebb. *Phys. Rev.* 46. *pp.* 17–32, *July* 1, 1934.—In rare-earth compounds the Verdet constant V should exhibit the same dependence upon temperature as does the magnetic susceptibility χ, even when Curie's law is not obeyed. In consequence of the similarity in the mode of variation with temperature for V and χ, existing data on the temperature variation of χ can be considerably enhanced by drawing upon the Faraday measurements of Becquerel and de Haas. In particular, information concerning the χ's for individual crystallographic axes thus become available in tysonite and the tests of calculations of the susceptibility with crystalline potentials become correspondingly severe. The triclinic field proposed by Kramers for tysonite does not appear to account for the behaviour of individual principal susceptibilities, although adequate for the mean characteristic of a crystal powder. It is shown that somewhat better agreement with experiment can be achieved by assuming tentatively that the local field has rhombic symmetry, with three possible orientations for the rhombic axes differing from each other by 120°, so that all told the crystal has the desired hexagonal symmetry. AUTHORS.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3245. Fluorescence of Pure Substances. E. Canals and P. Peyrot. *Comptes Rendus,* 198. *pp.* 1992–1994, *June* 4, 1934.—The method of detecting faint fluorescence by measuring the depolarisation factor previously described [see Abstract 1980 (1934)] has here been used on pure substances. A large number of pure liquids have been investigated. Water is faintly fluorescent as are all carbon compounds studied which contain oxygen as well as the cyclanes and their derivatives. The introduction of the methyl group reduces the fluorescence of the cyclanes while in the dimethyl derivatives the ortho and meta have similar values, but the para is practically non-fluorescent. The cyclenes are again fluorescent but here the introduction of a methyl or ethyl group greatly reduces and sometimes extinguishes the fluorescence. J. E.

3246. Fluorescence of Minerals. H. Haberlandt. *Akad. Wiss. Wien, Ber.* 143. *2a.* 1–2. *pp.* 11–13, 1934.—Many topaz specimens show a yellow to red radiophotofluorescence; observation and photography of the fluorescence spectra of scheelites and zircons of known origin indicate the presence of rare earths and in skapoliths the presence of uranium. J. E.

3247. Fluorescence of Fluorites. Part II. H. Haberlandt, B. Karlik and K. Przibram. *Akad. Wiss. Wien, Ber.* 143. *2a.* 3–4. *pp.* 151–161, 1934.—A continuation of previous work [see Abstract 5274 (1933)]. It is here shown that the fluorescence at low temperatures is due to special centres. Work with synthetic material showed that the blue fluorescence band is due to Eu and the green low-temperature band to Yt. The fact that the blue fluorescence of Eu-activated fluorite can be produced by reduction heating as well as by exposure to Ra suggests the connection between radiophotofluorescence and divalent state of rare earth. The line fluorescence of fluorite, yttrofluorite and yttrocerite under excitation by ultra-violet light was studied and agreement obtained with the well known lines attributed to rare earths. The paper is illustrated with spectrograms and photometer curves. J. E.

See also Abstracts 3252, 3324, 3421.

INTERFERENCE. DIFFRACTION AND SCATTERING.

3248. Iridescence of Ancient Glass. M. Guillot. *Comptes Rendus,* 198. *pp.* 2093–2095, *June* 11, 1934.—The iridescent patina of ancient glass is due to stratified layers of silica separated by layers of calcium carbonate. A mechanism is suggested for their formation as a type of Liesegang rings. A. S. C. L.

3249. Intensity Changes in Grating Spectrum. K. Zuber. *Helv. Phys. Acta,* 7–4. *pp.* 454–458, 1934. *In German.*—Describes a method of demonstrating how the intensities of the various orders of spectra given by a diffraction grating vary as the ratio of the space-width to spacing changes. Instead of Wood's wire grating, the author uses a grating made of narrow strips, 3 mm. wide and 0·25 mm. thick, spaced at 0·5 mm. intervals (gaps 0·25 mm. in breadth). As this grating is inclined to the incident light the ratio of space to spacing changes while the latter quantity remains sensibly constant. Photographs showing the resulting changes in the intensities of the various orders of spectra are reproduced in the paper. J. W. T. W.

See also Abstracts 3140, 3218, 3274, 3435, 3436.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3250. Photochemical Action of Complex Radiations. Part II. C. Winther. *Zeits. f. wiss. Phot.* 33. *pp.* 52–56, *June,* 1934.—The author's former criticism of Padoa and Vita's work is upheld [see Abstract 602 (1934).] T. H. P.

3251. Photochemistry of Simple Organic Compounds. K. F. Bonhoeffer. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 425–428, *July*, 1934.—A review of recent work on photochemical decomposition of simple molecules. The mechanism of the processes (*e.g.*, primary and secondary reactions : relation of light absorbing group to the point of decomposition in the molecule : thermal dissociation, etc.), is first discussed, and an account is then given of the photochemistry of saturated hydrocarbons, alkyl halides, alcohols, aldehydes and ketones, monobasic acids, and of the ethylenic double bond. C. B. A.

3252. Mercury Photosensitised Decomposition of the Deuteroammonias. J. C. Jungers and H. S. Taylor. *J. Chem. Phys.* 2. *pp.* 373–380, *July*, 1934.—A method of preparation of ammonias in which one, two and three H atoms are replaced by D has been devised. It reveals that the preparation of magnesium nitride from magnesium and ammonia yields amido- or imido-compounds as intermediate stages of great stability. The physical properties of deuteroammonia preparations have been studied. Ultra-violet absorption spectra reveal the presence of all three substituted deuteroammonias in the preparations studied. The mercury photosensitised decomposition of ND_3 is more than ten times slower than the corresponding reaction of NH_3. It is also inhibited much more strongly by D_2 than is NH_3 decomposition by H_2. Increasing deuterium content of ammonia decreases the rate of sensitised decomposition. The kinetics of decomposition are qualitatively similar but quantitatively different. The quantitative results are compared with data on quenching of fluorescence of mercury resonance radiation by the several gases in question and lead to important conclusions concerning the nature of the collisions involved in the decomposition process. AUTHORS.

3253. Focal Isolation versus the Monochromator for Photochemical Work in the Ultra-Violet. G. S. Forbes, L. J. Heldt and L. W. Spooner. *Rev. Sci. Instruments*, 5. *pp.* 253–255, *July*, 1934.—To obtain information as to the best source of the monochromatic light required for physical photographic and photochemical research, comparison is made between the output of an apparatus for focal isolation and that of a prism monochromator, quantitative measurements of intensity and spectral purity being made. For the group of Al lines about 194 $m\mu$, focal isolation is greatly to be preferred, as the spectral purity is 0·98 and the intensity 7 times as great as that obtainable with the comparator. For the group of zinc lines 203–214 $m\mu$, focal isolation is to be preferred on the score of intensity, provided that the spectral purity need not exceed 0·8. With all other spectral lines studied, the monochromator proved definitely superior, as the spectral purity was higher and the intensity still adequate for photochemical work. T. H. P.

3254. Photographic Intermittency Effect and the Discrete Structure of Light. L. Silberstein and J. H. Webb. *Kodak Research Lab., Comm. No.* 526., *Phil. Mag.* 18. *pp.* 1–24, *July*, 1934.—It is known that whilst, in general, an intermittent exposure does not produce the same photographic effect as does a continuous exposure of the same total energy yet, under certain conditions, the difference between the two types of exposure disappears. A thorough analysis of the problem is now made and the theory developed agrees well with the experimental findings. Actually, from the viewpoint of the quantum theory both types of exposure must be regarded as intermittent and their effects can only differ from each other through the spacing of the quantum hits, the intervals between successive hits and their probable distribution in time. The influence of these various factors is considered in detail and it is concluded that the frequency at which an intermittent exposure becomes experimentally indiscernible from a continuous one is directly proportional to the intensity of the exposing radiation and to the size of the emulsion grain, whilst it increases in a more complicated manner with the ratio of the dark to luminous periods. The experimental work described bears out well the predictions of the theory. A. H.

3255. Photographic Inversion due to the Simultaneous Action of Two Different Radiations. V. Dolejšek and A. Němejcová. *Comptes Rendus*, 198. *pp*. 2081–2082, *June* 11, 1934.—Inversion effects are observed when a photographic plate is subjected to the successive action of: X-rays and white light; kathode rays and white light; X-rays and heat rays; kathode rays and heat rays; kathode rays and X-rays. Except for the last pair, inversion occurs only if the radiation with the shorter wave-length is the first to act. T. H. P.

3256. Influence of Antioxygen Substances on the Sensitivity of Photographic Emulsions. A. Charriou and (Miss) S. Valette. *Comptes Rendus*, 198. *pp*. 2078–2080, *June* 11, 1934.—The sensitivity of a photographic emulsion is diminished by incorporation therewith of resorcinol, guiaiacol, phenol, aniline, nitrobenzene, diphenylamine or sodium salicylate; the last have the greatest effect. This observation is in accord with the general rule that such substances have a deactivating action on molecules excited by radiation. [See Abstract 1453 (1933).] T. H. P.

3257. Mechanism of Infra-Red Sensitisation. R. Mecke. *Zeits. f. Elektrochem*. 40. 7*b*. *p*. 511, *July*, 1934.—Red and infra-red sensitisers are basic colouring matters, and have the property, in solutions containing Ag ions, of reducing these, with a simultaneous disappearance of the typical red absorption to metallic Ag. In ammoniated dye solutions this separation of silver is prevented by formation of complex ions, but the further addition of NH_3 to the dye-stuff-Ag solution (hypersensitisation) produces, at not too high NH_3 concentrations, a slow separation of Ag. On shaking a dye solution with AgCl, the colour disappears owing to adsorption of the dye. The colour is restored on dissolving the precipitate in NH_3, but if the adsorbed dye is irradiated with deep red light, it decomposes producing Ag. These experiments show that in the primary photoprocess, the dye takes part directly in a reaction, *i.e.*, the neutralisation of the Ag-ion in the AgBr lattice which is necessary for the formation of a latent image is not brought about by the Br-ion but by the dye. Pinacyanol, rubrocyanin and allocyanin are investigated and a reaction mechanism is suggested. C. B. A.

3258. Constancy in Properties of X-Ray Film Emulsions. A. Kohaut and G. Spiegler. *Zeits. f. wiss. Phot*. 33. *pp*. 39–47, *June*, 1934.—Apparatus and technique are described for testing the constancy in sensitivity and gradation of successive deliveries of X-ray film emulsions of any one brand. T. H. P.

3259. Herschel Effect on Red- and Infra-Red-Sensitive Photographic Layers. J. Narbutt. *Zeits. f. wiss. Phot*. 33. *pp*. 48–51, *June*, 1934.—This effect has been shown with a number of plates sensitised to red by pinaverdol, pinacyanol, or pinachrome blue, and by infra-red Agfa and Ilford plates. T. H. P.

3260. Heat as an Agent for the Production of the Latent Photographic Image. J. M. Blair and P. A. Leighton. *J.O.S.A.* 24. *pp.* 185–187, *July*, 1934.—Eastman lantern slide plates are heated at various temperatures and for various intervals in an electric oven and a study is made of the images obtained on processing. High densities are producible and these are uniform over the plates except those produced by low temperatures. Curves are plotted of the density against the exposure time for the various temperatures and these are strikingly similar to the density-time curves obtained for exposure to light. It is concluded that there is an essential similarity between the latent images produced by light and heat. A. H.

3261. Colour Filters. S. O. Rawling. *Phot. J.* 74. *pp.* 295–305, *June*, 1934.—Deals with colour filters, particularly referring to their uses in photography. After a brief consideration of the nature of colours and the response of the eye to them, the response of various typical photographic materials to the colours is dealt with. The use of filters in the photography of coloured objects is then discussed, and finally the photography of landscapes and the obtaining of colour contrasts by means of filters is considered. R. C. F.

See also Abstracts 3167, 3299, 3300.

PHOTOMETRY.

3262. Heterochromatic Photometry by Absolute Method. H. König. *Helv. Phys. Acta*, 7. 4. *pp.* 427–453, 1934. *In German.*—The author first deals with the theoretical difficulties of heterochromatic photometry and the necessity for defining the conditions under which measurements are made. He then describes a method which is a combination of two which have been used previously in physical photometry, *viz.*, compound colour filters and a spectrum templet. The measuring element is a selenium photovoltaic cell. Various combinations of filters with corresponding correcting templets are described and their performance is compared with the standard luminosity curve. It is found possible to obtain exceedingly accurate reproduction with a sensitivity of 7×10^{-10} ampere per lux. J. W. T. W.

o **3263. Transmission Measurements with Hilger Rotating Sector Photometer. A. Dingwall, R. G. Crosen and H. T. Beans.** *Rev. Sci. Instruments*, 5. *pp.* 248–250, *July*, 1934.—Describes devices used to facilitate the adjustment of the light source and the sector photometer in relation to the spectrograph. The new technique adopted by the authors for determining light transmission values enables twelve individual measurements to be made at each wave-length from each plate, the estimated accuracy for the mean of a number of values being 0·5 %. J. W. T. W.

3264. Ratiometer for Intensity Analyses of Microphotometer Records. G. O. Langstroth. *Rev. Sci. Instruments*, 5. *pp.* 255–256, *July*, 1934.—Describes a mechanical device by means of which it is possible to carry out very quickly an analysis of a microphotometer record of a spectrogram, so that a continuous curve of intensities can be drawn directly from the record. J. W. T. W.

See also Abstracts 3105, 3253, 3271, 3423.

POLARISATION.

3265. Polarisation of Light Scattered by Binary Mixtures near the Critical Point. A. Rousset. *Comptes Rendus,* 198. *pp.* 2152–2154, *June* 18, 1934.—Light scattered by a mixture of two liquids gets more intense as the critical temperature of complete miscibility is approached. The scattering is usually attributed to local fluctuations of concentration, and this requires the light scattered at 90° to be completely polarised. Rocard has found incomplete polarisation, and attributed it to a supplementary scattering due to fluctuations in the molecular field [see Abstract 457 (1929)]. In this paper the polarisation is investigated for isobutyric acid-water, and hexane-nitrobenzene mixtures respectively, for about 10° C. range above the critical temperature. The curves (of depolarisation against temperature excess above the critical) for the two mixtures have the same character, and from the changes in slope the author deduces that the depolarisation is due to secondary (depolarised) scattering superposed on the primary scattering, and that Rocard's explanation is untenable. A. C. M.

3266. Optical Rotatory Power. T. M. Lowry. *J. de Physique et le Radium,* 5. *pp.* 225–229, *June,* 1934.—The principal features of the phenomenon of optical rotatory power are briefly described, together with the physical, chemical, electronic and molecular theories of its origin. An account is given of attempts which have been made by de Malleman and by Boys to calculate rotatory power and rotatory dispersion for simple active molecules in terms of the refractivities of the substituent atoms or radicals, and the results are discussed in the light of the remarkable anomaly observed in the curves of rotatory dispersion for aldehydes and ketones at wave-lengths inside the absorption bands of these substances. It is shown that the molecular theories cannot account for this anomaly in terms of the refractivity of the ketone radical, but that they might do so if they are modified so as to take account of the theory of induced dissymmetry put forward by Lowry and Walker. C. B. A.

3267. Origin of Optical Rotatory Power and of Anomalous Rotatory Dispersion in Aldehydes and Ketones. T. M. Lowry. *Zeits. f. Elektrochem.* 40. 7b. *pp.* 475–478, *July,* 1934.—The molecular theories of rotatory power developed by de Mallemann and by Boys predict the value of the rotatory power of a dissymmetric molecule consisting of four different radicals round a central C-atom in terms of the refractivities R_A, R_B, etc., of the radicals and the dimensions of the tetrahedron formed by them, an expression containing the product $R_AR_BR_CR_D/\lambda^2$ being obtained. This expression also allows of the calculation of the rotatory dispersion of *sec.* butyl alcohol in the visible spectrum, but gives too low values for *act.* amyl alcohol. At the centre of the ultra-violet ketonic absorption band, the rotatory dispersion of aldehydes and ketones shows a striking anomaly and passes through a zero value. This can only be predicted if the refractivity of the $> C = O$ radical passes through a zero value, which is not the case. It is suggested that the condition might be fulfilled by the existence of a second asymmetric centre within the chromophoric group, corresponding to the theory of induced dissymmetry put forward by Lowry and Walker. C. B. A.

RADIATION, EMISSION.

3268. Detection of Radio Waves by a Dry Cell Consisting of a Solid Electrolyte and Ionised Air. L. Bouchet. *Comptes Rendus,* 198. *pp.* 1982–1983, *June* 4, 1934.—One electrode consists of carbon 27 × 8·5 cm., with a cavity therein 0·5–0·7 mm. deep, which is filled with the solid residue obtained on heating Joachimstal pitchblende with 50 % H_2SO_4, the whole being then stoved; the other is a thick plate of zinc 23 × 5·9 cm., separated from the active material by three sheets of mica 0·3–0·4 mm. thick. With two Daniell cells in series a current of 8×10^{-8} A was obtained and, on reversing the cells, a current of 230×10^{-8} A. Preliminary tests of its use as a detector were satisfactory. C. A. S.

3269. Radio Exploration of the Ionosphere. E. V. Appleton. *Nature,* 133. *p.* 793, *May* 26, 1934.—(*a*) Measurement of the earth's magnetic field in the ionosphere.—The magneto-ionic doubling of wireless echoes has been explained in terms of the theory of double refraction. Earlier tests were directed towards proving the magneto-ionic theory, making the assumption that the magnetic field in the ionosphere was about the same strength as at ground level. Now, the quantitative correctness of the magneto-ionic interpretation is assumed, and careful measurements made to determine the field-strengths in the ionosphere. The values thus found support the theory of Schmidt, according to which the value calculated for 200 km. elevation is about 10 % less than that at ground level. (*b*) A new method of ionospheric investigation.—For measuring the group-time of an echo a mark must be impressed on the signal so that it can be recognised on its return to the ground. There are advantages in using for this purpose a combination of the frequency- and amplitude-modulation methods, so as to produce a frequency change on a pulse emitter. This permits resolution of echoes as obtainable with an extremely brief pulse. Differences of equivalent height of 1 km. or less can be detected in this way. The tuning of sender and receiver must be automatically maintained during the frequency change. R. M.

3270. Analysis of the Cosmic-Ray Absorption Curve. C. Eckart. *Phys. Rev.* 45. *pp.* 851–859, *June* 15, 1934.—A method of solving the integral equation of absorption, $f(s) = \int_0^\infty \phi(\mu) \exp(-\mu s) d\mu$, is developed which gives the function ϕ as a series of Laguerre orthogonal functions, whose coefficients are determined from the power series expansion of a function $F(x)$. This in turn is simply related to the given function $f(s)$; in case the latter is given numerically, the expansion may be accomplished by the method of least squares. The function ϕ (called the absorption coefficient spectrum of the radiation) is determined for cosmic rays at several altitudes and latitudes. In each case there are two maxima of intensity, one at $\mu = 0·06$ and one at $\mu = 0·6$ (meters water)$^{-1}$. The minimum of intensity occurs at $\mu = 0·25$, or $1/\mu = 4$ m. water = 30 cm. mercury. This is also the range of the rays responsible for the inflection points of the Compton-Stephenson high-altitude curve, but no consistent explanation of the correlation is found. The spectrum also shows a range of negative intensity, indicating the presence of secondary radiations. In no case is there any evidence for a line structure of the spectrum. No basis is found for restricting the assumption of exponential absorption to apply only to equatorial data; neither is any evidence discovered which makes the assumption a necessary one at any

latitude. Only data on the absorption in air and water are considered; several points are indicated at which the existing data require extension.
AUTHOR.

See also Abstracts 3208, 3229, 3325, 3344, 3401, 3422.

REFLECTION. REFRACTION AND DISPERSION.

3271. Measurement of Diffuse Reflection Factor. F. Benford. *J.O.S.A.* 24. *pp.* 165–174, *July*, 1934.—Describes a reflectometer of the diffusing hollow sphere type for measuring the reflection factors of materials which are not themselves perfect diffusers. The main part of the sphere (about 2½ in. dia.) consists of two hollowed blocks of magnesium carbonate. The aperture, about 2 in. in dia., is covered with a thin sheet of glass etched on both sides. The sample to be measured is placed in contact with the external surface of this glass. Complete details of the construction and method of calibration of the instrument are given. The cone of illumination of the sample is adjusted so that specular surfaces give a diffuse reflection factor equal to that found for them by specular reflection at an angle of 45°. J. W. T. W.

3272. Reflection Factors for Visible and Ultra-Violet Light. A. H. Taylor. *J.O.S.A.* 24. *pp.* 192–193, *July*, 1934.—Describes measurements made with an absolute reflectometer, of the reflection factors of a number of substances (*a*) for the visible spectrum and (*b*) at wave-length 296·7 $m\mu$, the region of maximum therapeutic effect. The substances measured include a number of metals (including aluminium surfaces with various treatments), water paints and miscellaneous substances. MgO has a reflection factor of 95 % at 296·7 $m\mu$, while a special Al alloy sputtered on glass has a reflection factor of 95 % in the visible and 87 % at 296·7 $m\mu$. J. W. T. W.

3273. Effect of Dyes on Reflection of Light from Textiles. R. Guelke and Margaret M. Fitzsimons. *Faraday Soc., Trans.* 30. *pp.* 512–519, *July*, 1934.—The diffuse reflection from dyed cloth is found to conform to the formula $Bc = \log\{(A - 1)/(A - I_0/I)\}$, which can be derived theoretically from the consideration of a simple model involving alternate reflection and absorption of the incident lights. AUTHORS.

3274. Validity of the Berek Theory of Image Formation in a Microscope. G. Stade. *Zeits. f. Physik*, 89. 5–6. *pp.* 286–307, *June* 2, 1934.—By transformation of the general diffraction theory equations for image formation, it is shown that the focussing of a non-self-luminous object is equivalent to that of a self-luminous object when the intensity distribution produced by the former in the entrance pupil of the focussing objective corresponds to that of the latter. The integration of the general equations is carried out, and practical examples are considered. The general validity of the consonance formula is confirmed. [See Abstract 1721 (1927).] C. B. A.

3275. Measurement of Small Variations of Refractive Index of Solid Bodies. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 93–99, *June* 16, 1934.—The proposed method consists in comparing the results obtained when either Michelson's or Cotton's method of studying optical systems is used, first for a system formed with a collimator objective and a telescope objective, and then for the system obtained by interposing between these objectives the prism composed of the material to be studied. The variation, Δn, of the index is given by the relation $\Delta n = a\lambda/d$, where a is the displacement of the central fringe, measured in fringes, and d is the thickness of the prism in front of the movable slit or of the second slit. The observations are simple and can be carried out photographically. [See Abstract 2824 (1932).] W. D. W.

3276. Double Refraction in a Calcite Sphere. G. Laemmlein. *Zeits. f. Krist.* 88. *pp.* 332–336, *July*, 1934.—The optical behaviour of such a sphere is discussed (*a*) perpendicular to the optic axis, (*b*) parallel to the optic axis. The caustic produced is considered in detail. From projection, it is possible to show the change of the "extraordinary" caustic, and the invariance of the "ordinary" one. If a nicol is used, either caustic can be excluded. F. I. G. R.

3277. Developments in Microscopy. F. F. Lucas. *Frank. Inst., J.* 217. *pp.* 661–707, *June*, 1934.—The paper describes the developments that have been made in ultra-violet microscopy and high-power microscopy during the past ten years at the Bell Telephone Laboratories. The ultra-violet microscope has been used mainly for biological purposes using a wave-length of 2750 Å. One important development is the use of optical sectioning, in which a series of photographs are taken of different planes of the object, each plane being separated from the previous one by $0 \cdot 25\ \mu$. This is possible, since the depth of focus of the ultra-violet objective is very small. The value of microphotometric measurements of photographs taken with the ultra-violet microscope have also been investigated. It has been found that measurements of the absorption of ultra-violet radiation by living cells at different stages of their growth yield valuable information and open up a promising field of research. For example, results for a group of rat sarcoma cells and mouse sarcoma cells each show a constant relation between the absorptions in the nuclear membrane and in the nuclear contents. Investigations have also been made on the action of various wave-lengths on living cells and for the organism, Glaecopsa, 2265 Å produced very rapid changes and disintegration. These were observed by irradiating with the active wave-length for short periods and photographing the result using 2750 Å. The method has also been applied to malignant tumor cells. A report is also given of the use of a mono-brom-naphthalene objective with an N.A. of $1 \cdot 60$ as applied to metallography. This was used with light from the blue end of the visible spectrum. W. D. W.

See also Abstracts 3140, 3266, 3267, 3410.

SPECTROSCOPY.

3278. Wave-Lengths and Terms of the Fluorine Spectrum, FV. B. Edlén. *Zeits. f. Physik*, 89. 9–10. *pp.* 597–600, *June* 26, 1934.—In continuation of previous work [see Abstract 2886 (1934)], the FV spectrum has been analysed, 90 doublet and 40 quartet lines have been identified, mostly in the extreme ultra-violet, and 58 doublet and 24 quartet terms established. The ionisation potential is given as $113 \cdot 670$ volts. F. S.

3279. Distribution of Light from Gas and Vapour Discharges. H. C. Rentschler. *Am. Illum. Eng. Soc., Trans.* 29. *pp.* 439–443, *June*, 1934.—Briefly summarises several of the more important factors in the production of light by gas and vapour discharges, giving spectrograms of the radiation occurring in the visible spectrum. R. C. F.

3280. Mean Life of the 7^3S_1 State of Mercury from Polarisation Measurements on the Visible Triplet. A. C. G. Mitchell and E. J. Murphy. *Phys. Rev.* 46. *pp.* 53–57, *July* 1, 1934.—Fluorescence of the visible triplet lines of mercury (4047, 4358, 5461) was obtained by exciting a mixture of mercury vapour and a small amount of nitrogen by radiation from a quartz-mercury arc. The fluorescence was observed at right angles to the exciting light beam and the polarisation of each line, isolated by suitable filters, was measured by the method of crossed Wollaston prisms. Measurements in zero magnetic field (polarised excitation) gave 88·2 % for 4047, – 65·5 for 4358, and 14·55 for 5461, compared to theoretical values (broad line excitation) of 84·7, – 67·0, and 8·7 %, respectively. Measurements were then made of the polarisation as a function of a magnetic field applied in the observation direction and the mean life of the 7^3S_1 state calculated from the data. The mean life of this state as measured by 4047 and 4358 was $0·8 \pm 0·1 \times 10^{-8}$ sec. at about 3·0 mm. nitrogen pressure. The mean life as measured by the line 5461 was about $0·6 \pm 0·1 \times 10^{-8}$ sec. The collision cross section for the 7^3S_1 state against nitrogen was measured by measuring the polarisation of 4358 at a field of 3 gauss and varying nitrogen pressures, giving the result $\sigma_q^2 = 1·3 \times 10^{-16}$ cm². AUTHORS.

3281. Line Absorption Spectrum of Crystalline Chrome Alum. F. H. Spedding and G. C. Nutting. *J. Chem. Phys.* 2. *pp.* 421–431, *July*, 1934.—The line absorption spectrum of chrome alum has been photographed at five temperatures from 85° to 14° K. The variation with temperature of the intensities of certain of these lines suggests the existence of one or more excited lower levels. At 14° K. a new group of faint, sharp lines appears near 4500 Å. A general discussion of the nature of energy levels in solids is presented and the possible energy states which could give rise to the observed lines are examined theoretically.

AUTHORS.

3282. Spectra of Columbium V and Molybdenum VI. M. W. Trawick. *Phys. Rev.* 46. *pp.* 63–65, *July* 1, 1934.—The Rb I-like spectra of columbium and molybdenum have been excited in a vacuum spark and photographed with a vacuum spectrograph. Identifications of lines corresponding to the transitions $5s\ ^2S - 5p\ ^2P$, $5p\ ^2P - 5d\ ^2D$, $5p\ ^2P - 6s\ ^2S$, $4d\ ^2D - 5p\ ^2P$, and $4d\ ^2D - 4f\ ^2F$ for Cb V and Mo VI have been facilitated by extrapolation from the corresponding lines in the spectra of the four preceding elements in the Rb I-like isoelectronic sequence. The relative term values $4d\ ^2D$, $5s\ ^2S$, $5p\ ^2P$, $4f\ ^2F$, $5d\ ^2D$, and $6s\ ^2S$ have been determined. Absolute term values have been approximately fixed by extrapolating $\nu^{\frac{1}{2}}$ for the terms of the sequence in such a way as to maintain the validity of the irregular doublet law and they have been compared with those obtained by applying the Rydberg formula to the ^2S and ^2D terms, and with those found by extrapolating values of the quantum defects for the ^2S and ^2P terms. AUTHOR.

3283. Spectrum of Selenium. Part III. Extension of Se III. K. R. Rao and S. G. K. Murti. *Roy. Soc., Proc.* 145. *pp.* 681–694, *July* 2, 1934.—A further study of the spectrum of selenium [see Abstract 3542 (1933)] has revealed about 15 new levels assignable to the doubly-ionised atom and arising chiefly from the 6*s* and 5*d* electron configurations; about 120 lines have thus been newly classified. An investigation of the infra-red region of the spectrum has led to the confirmation of the 5*s* and 4*d* terms previously identified. The limits to which the component levels tend to converge have been discussed. [See following Abstract.] AUTHORS.

3284. Spectrum of Selenium. Part IV. Se I and Se VII. K. R. Rao and S. G. K. Murti. *Roy. Soc., Proc.* 145. *pp.* 694–698, *July* 2, 1934.—About 50 lines have been newly ascribed to the neutral atom of selenium mainly by a study of uncondensed discharges through capillary tubes, and of arcs in an atmosphere of nitrogen. Eight new levels have been identified. A study of very highly condensed and violet vacuum sparks has led to the assignment of about 40 lines in the region λ 860–λ 560 to the spectrum of Se VII and some tentative classifications are suggested. [See preceding Abstract.] AUTHORS.

3285. Width of Neon Lines. E. Lau and J. Johannesson. *Phys. Zeits.* 35. *pp.* 457–460, *June* 15, 1934.—The natural half-widths of Ne lines which were previously measured only at the foot of each line [see Abstract 4923 (1933)] are now measured at the half-intensity points. In agreement with the previous measurements it is found that those lines whose lower state is an S_2-term are essentially wider than the other lines. It is confirmed also that the natural half-widths are from two to five times greater than those found by Schutz and Schillbach. The values of the half-widths are found to be independent of the conditions of excitation of the lines; the absorption lines behave in the same way as the emission lines. J. E. K.

3286. Pressure Broadening and Pressure Displacements in the Fourth Term of the Principal Series of Cæsium. F. Gössler and H. E. Kundt. *Zeits. f. Physik*, 89. 1–2. *pp.* 63–67, 1934.—The influence of He, Ne, A and N on the 3612 Å line of Cs is discussed. The values of the asymmetry, half value breadth at 400° K. and 700 mm. and displacements have been estimated. W. R. A.

3287. Collision Broadening of the Rotation-Vibration Lines of HCl Due to Added Gases. W. Grasse. *Zeits. f. Physik*, 89. 5–6. *pp.* 261–272, *June* 2, 1934.—The absorption increase through the addition of He, H_2, A, N_2, and CO_2 at $\frac{2}{3}$ atmosphere to HCl at $\frac{1}{3}$ atmosphere was measured. A method is given for the quantitative calculation of the broadening of the lines, and the molecular separations are thence calculated. The ratios of these separations to those found from the kinetic theory are discussed, and the larger discrepancy found with He explained by considering the theoretical definition of the optical cross-section. W. R. A.

3288. Nuclear Moments of Antimony Isotopes—Discussion of Landé's Theory. M. F. Crawford and S. Bateson. *Canad. J. of Research*, 10. *pp.* 693–702, *June*, 1934.—Hyperfine structures in the Sb IV spectrum have been investigated. Analysis of the hyperfine patterns shows that the I-values of Sb^{121} and Sb^{123} are $\frac{5}{2}$ and $\frac{7}{2}$ respectively, in agreement with those deduced by Badami from Sb II. The magnetic moments of Sb^{121} and Sb^{123}, calculated from the hyperfine separations in Sb IV, are 4·0 and 3·2 proton magnetons respectively. For antimony the ratio of the $g(\mathrm{I})$ factors is $g(\mathrm{I})_{121}/g(\mathrm{I})_{123} = 1{\cdot}82 \pm {\cdot}02$. The application of the Landé $g(\mathrm{I})$ formula to this accurate ratio leads to a value $g_s = 3$ for the magnetic factor of the proton spin, instead of $g_s = 4$ as found by Landé. The value $g_s = 3$ gives slightly better general agreement between the observed and the calculated $g(\mathrm{I})$ factors than is obtained for $g_s = 4$. However, since no specific value of g_s will satisfy the accurate ratio criterion for all the Z_{odd}, M_{odd} isotopes to which the test can be applied, it is concluded that the theory is incomplete. AUTHORS.

3289. Nuclear Moment of Tl. L. A. Wills. *Phys. Rev.* 45. *pp.* 883–885, *June* 15, 1934.—The value of $\psi^2(0)$ for the 7*s* state of Tl I is calculated relativistically and compared with the value determined from the formula $\psi^2(0) = Z_i Z_0^2/\pi a^3_H n_0^3$. With the experimental value of the hyperfine structure splitting of this level, the magnetic moment of the Tl nucleus is found to be : $1840g \cong 2 \cdot 7$. The f values corresponding to the transitions $p_{3/2}s_{1/2}$ and $p_{1/2}s_{1/2}$ are also determined and are found to be in agreement with experiment when the effect of a perturbation is taken into account. AUTHOR.

3290. Infra-Red Reflection Spectrum of Silicates. C. Schaefer, F. Matossi and K. Wirtz. *Zeits. f. Physik*, 89. 3–4. *pp*. 210–233, *May* 24, 1934.—Measurements of the infra-red reflection spectrum over the range 8 to 20 μ for about twenty silicate minerals, are described. Tables of the reflection maxima obtained, together with similar data for other silicates determined in previous investigations show that reflection bands between 8 and 12 μ and 17 and 20 μ appear consistently and must be due to the SiO_4 group or its polymerisations. An intermediate band between 14 and 18 μ observed for some silicates is attributed to coordination polyhedra (AlO_6, BeO_4) formed by the grouping of SiO_4 groups about Al or Be atoms with sharing of O atoms. The short-wave SiO_4 band was found to be displaced progressively towards the short waves with increasing association of the SiO_4 tetrahedra. Weiler's allocation of the four fundamental frequencies of vibration of the SiO_4 tetrahedron is criticised and an alternative scheme more in accord with the infra-red spectra and with theory, is put forward. W. S. S.

3291. Nuclear Oscillation Bands of Solid and Liquid HCl between 20° and 160° Absolute. G. Hettner. *Zeits. f. Physik*, 89. 3–4. *pp*. 234–243, *May* 24, 1934.—Measurements are described of the spectral absorption of a thin film of HCl in the solid or liquid state, formed by condensation on a copper mirror mounted on a rod which dipped into liquid air or hydrogen. By raising or lowering the rod in the cooling medium a convenient temperature range from 20° to 160° could be covered. For the liquid HCl and for the β-modification of the solid (formed above 98·8° Abs.) a simple absorption band with its maximum at about 3·60 μ was obtained. Below the transition point, a double band with maxima at 3·64 and 3·69 μ appeared but at still lower temperatures (below about 38° Abs.) the absorption spectrum showed a single asymmetric band peaking at about 3·60 μ. Preliminary values for the dielectric constant of the α- and β-solid HCl are quoted. W. S. S.

3292. Pure Rotation Spectrum of the HCl Flame. J. Strong. *Phys. Rev.* 45. *pp*. 877–882, *June* 15, 1934.—Pure rotation lines for $j = 17$ to 33 of the emission spectrum of the HCl flame are measured with a KBr prism. The following empirical formulæ are determined to represent two series of lines measured corresponding to pure rotation in the two lowest oscillation states, $N = 0$, $\nu = 20 \cdot 9j - 0 \cdot 00185j^3$; $N = 1$, $\nu = 20 \cdot 2j - 0 \cdot 00163j^3$. The linear coefficients agree satisfactorily with values calculated from the empirical oscillation-rotation formula. Theoretically the two cubic coefficients should be equal. The frequency is strongly influenced by the cubic term for high values of j so that the observed difference between these coefficients is regarded as real. [See Abstract 1520 (1933).] AUTHOR.

3293. Infra-Red Spectra and Structure of Polyatomic Molecules. R. Titeica. *Ann. d. Physique*, 1. *pp*. 533–621, *May–June*, 1934.—With a rock-salt prism, the absorption spectra are measured between 1·5 μ and 16·5 μ for a number of substances : aliphatic aldehydes and ketones,

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formates, acetates and propionates, ethyl alcohol and ethyl ether, all in the state of vapour, at a low pressure. The object of using the vapours was to avoid the possibility of association, so common in the liquid state. By adding the data from Raman effect measurements by other workers, and data from the far-infra-red, the structures of some of the molecules concerned have been elucidated. The moments of inertia obtained for formaldehyde, for example, are in good agreement with those calculated from the fine-structure of infra-red and ultra-violet bands. A. C. M.

3294. Spectroscopic Determination of Structure of Simple Hydrocarbons and their Derivatives. R. Mecke, P. Gänswein and O. Vierling. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 474–475; *Disc.*, 475, *July*, 1934.—A summarising account is given of the results obtained photographically, with a concave grating and a 20 m. tube at high pressures, for the near infra-red overtones of the simpler hydrocarbons and their halogen and simpler oxy-derivatives (*e.g.*, ethylene oxide and dioxane). The spectra of the hydrocarbons allow of conclusions with regard to free rotation and the degree of saturation of the C — C bonds. The substitution of halogen atoms affects the intensities but not the positions of the bands. C. B. A.

3295. Infra-Red Spectrum of Heavy Water and the Angle of the Water Molecule. E. Bartholomé and K. Clusius. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 529–531, *July*, 1934.—The infra-red spectrum of water vapour with various D content is investigated between 2 and 10 μ. Bands are located as follows:

	H_2O	HDO	D_2O
$\nu(\delta)$	3765 cm^{-1}.	3690 cm^{-1}.	2755 cm^{-1}.
$\delta(\pi)$	1595 cm^{-1}.	1380 cm^{-1}.	1185 cm^{-1}.

Each water molecule thus has two active infra-red vibrations, but the result does not agree with that of R. W. Wood's Raman effect measurements. No $\nu(\pi)$ absorption is observed. The angle of the water molecule is deduced and found to agree within experimental error with Mecke's value of 103° 40′. The apparatus is not sensitive enough to detect any difference in angle between H_2O and D_2O. C. B. A.

3296. Spectroscopic Study of Phloridzin and Its Derivatives. Ultra-Violet Spectra of Phloretin, Phlorin and Phloroglucinol. A. Lambrechts. *Comptes Rendus*, 198. *pp.* 1852–1854, *May* 23, 1934.—Phloroglucinol and the derivatives mentioned show definite evidence of the existence of keto and enol forms; such tautomerism is most pronounced in the case of phloroglucinol. H. F. G.

3297. Diffuse Band Systems in the Absorption Spectrum of TlCl Vapour. H. Neujmin. *Phys. Zeits. d. Sowjetunion*, 5. 4. *pp.* 580–585, 1934. *In German.*—New diffuse band systems were observed in the absorption spectrum of Tl Cl vapour which closely adjoin the known continua at 3106 and 2510 Å on the long-wave side. They are only observed under quite definite temperature and pressure conditions. Such diffuse band systems, adjoining a continuum, render possible a trustworthy arrangement of this continuum for definite dissociation processes. J. J. S.

3298. Absorption Spectrum of Oxygen. L. Herman. *Comptes Rendus*, 198. *pp.* 2154–2156, *June* 18, 1934.—The spectrum between 7000 and 8000 Å of the light from an incandescent lamp is recorded after passage through a tube 100 m. long, containing O_2 up to pressures of

13 kg./cm^2., and is compared with the spectrum of the setting sun. Various bands are recorded, and their appearance in the sun's spectrum noted. A. C. M.

3299. Physico-Chemical Studies of Complex Organic Molecules. Part I. Monochromatic Irradiation. F. P. Bowden and C. P. Snow. *Roy. Soc., Proc.* 115. *Sect. B. pp.* 261–273, *June,* 1934.—A method is described for the production of monochromatic light of sufficient intensity to bring about reasonably rapid photochemical changes. The irradiation can be performed on very small amount of material and the progress of the reaction followed spectroscopically. Selective monochromatic irradiation is applied to some large molecules of biological importance, notably ergosterol and calciferol, vitamin B_1, carotene and vitamin A. C. B. A.

3300. Physico-Chemical Studies of Complex Organic Molecules. Part II. Absorption Spectra at Low Temperatures. F. P. Bowden and S. D. D. Morris. *Roy. Soc., Proc.* 115. *Sect. B. pp.* 274–278, *June,* 1934.—The absorption spectra of a number of important biological molecules have been measured at liquid air temperature. The bands of β-carotene (in ethyl alcohol) become narrower and shift to 4990, 4670 and 4350 Å, and a new band appears at 4060 Å. The ultraviolet band at 2700 Å becomes sharper but is little displaced. The main band of vitamin A concentrates at 3280 Å, is shifted to 3350 Å and new bands appear at 2900, 2770, 2580, 2510 and 2430 Å. The irradiation product of carotene whose absorption band at room-temperatures resembles that of vitamin A develops a structure at low temperatures with bands at 3780, 3570, 3410 and 3210 Å, showing that the two substances are not the same. The absorption spectrum of vitamin E concentrates is due to several different molecules and some progress has been made in separating out their respective spectra. C. B. A.

3301. Absorption Spectra of Ethyl Nitrate, Ethyl Nitrite, and Nitroethane. Janet W. Goodeve. *Faraday Soc., Trans.* 30. *pp.* 504–508, *July,* 1934.—The absorption of ultra-violet light by the vapours of ethyl nitrate, ethyl nitrite, and nitroethane, has been measured quantitatively, and values for the extinction coefficients have been determined. In each case the absorption appears to consist of two broad continuous bands overlapping one another. The extinction coefficient curve of ethyl nitrate is very similar to that of nitroethane, but quite different from that of ethyl nitrite. The absorbing group in all cases is considered to be the nitrogen-oxygen group, but the mode of dissociation is not discussed at this stage. AUTHOR.

3302. Absorption Spectra of Polyatomic Molecules Containing Methyl and Ethyl Radicals. H. W. Thompson. *Chem. Soc., J. pp.* 790–797, *June,* 1934.—As the first part of a series in which the absorption spectra of certain polyatomic molecules containing methyl and ethyl radicals are being examined, the results with dimethyl- and diethyl-zinc and tetraethyl-lead are reported. The spectrum of the first is continuous, that of the second shows diffuse bands with an overlapping continuum, and that of the third gives a quite different, sharp, band system. Attempts are made to correlate the vibration levels induced by electronic excitation with types of vibration theoretically known to occur, and with the Raman frequencies. AUTHOR.

3303. Band Spectrum of CS. F. H. Crawford and W. A. Shurcliff. *Phys. Rev.* 45. *pp.* 860–870, *June* 15, 1934.—The emission spectrum of CS has been photographed under high dispersion (0·28 Å per mm.) permitting a considerable extension of the data of the main $A^1\Pi \rightarrow x^1\Sigma$ system ($\nu_e = 38{,}912 \cdot 15$ cm^{-1}), and revealing a new system $C^1\Sigma \rightarrow B^1\Sigma$ ($\nu_0(0,0) \cong 39{,}905 \cdot 1$ cm^{-1}). The anomalies of bands with extra heads or displaced origins (noted by Jevons) have been examined in detail and found to be due to rotational perturbations more widespread and striking than any previously reported. AUTHORS.

3304. Band Spectrum of Ionised Aluminium Hydride. G. M. Almy and M. C. Watson. *Phys. Rev.* 45. *pp.* 871–876, *June* 15, 1934.—The Schüler hollow aluminium kathode lamp, containing helium and hydrogen, maintained at 2000 volts d.c., has been used to excite the band spectrum of AlH, which has been photographed with a 21-foot grating spectrograph. Among the new systems appearing there is one with principal head at 3632 Å which on analysis proves to consist of the (0,0) and (1,1) bands of a $^2\Pi$ (regular)$\rightarrow ^2\Sigma^+$ system due to AlH$^+$. The $^2\Pi$ state is found to be regular and not inverted as suggested by Holst [see Abstract 2903 (1934)]. The various band constants are obtained and the spin and Λ-doubling compared with theory. AUTHORS.

3305. Nitrogen Molecular Spectra in the Vacuum Ultra-Violet. W. W. Watson and P. G. Koontz. *Phys. Rev.* 46. *pp.* 32–37, *July* 1, 1934.—Nitrogen molecular spectra in the region from 900 Å to 2300 Å have been photographed with a 10-foot vacuum spectrograph giving a dispersion of 5·5 Å/mm. Partial rotational quantum analyses have been made for several bands of the $a^1\Pi_u \rightarrow {}^1\Sigma_g{}^+$ system yielding the constants $B_0' = 1 \cdot 632 \pm 0 \cdot 002$, $B_0'' = 1 \cdot 998 \pm 0 \cdot 002$, $\alpha' = 0 \cdot 021$, $\alpha'' = 0 \cdot 018$. Many new bands in a nitrogen band system with an origin at 1847 Å discovered by Hopfield in a condensed discharge in a helium-nitrogen mixture are reported. This system is due to $N_2{}^+$, having the same lower state as that of the first negative system. The rôle of the helium is discussed. Birge and Hopfield's b' progression is found to consist of Q branches only with $B' = 1 \cdot 147$. Several new N_2 ground state progressions among the bands in the 900 Å–1300 Å interval are presented. AUTHORS.

3306. Characteristic OH Band in Very Near Infra-Red. A. Naherniac. *Comptes Rendus,* 198. *pp.* 1685–1687, *May* 7, 1934.—Liquid alcohols show a simple OH band, and vapours (except tertiary alcohols and phenol) a doublet. The intensity increases from primary to tertiary alcohols, and is also greater in the vapours and the dilute alcohols. The results are tabulated and discussed. W. R. A.

3307. Degeneracy, Selection Rules and Other Properties of the Normal Vibrations of Certain Polyatomic Molecules. E. B. Wilson, Jr. *J. Chem. Phys.* 2. *pp.* 432–439, *July,* 1934.—The number, degeneracies, and symmetries of the normal modes of vibration are given for molecules in which several atoms are bonded to a central atom. Ninety-nine symmetries, including all possible structures with three to seven atoms and the more important structures of eight and nine atoms are listed in tables. The selection rules for the Raman and infra-red spectra are included as well as the polarisation properties of the Raman lines and the rotational structure of the vibrational bands. In a number of more important cases figures are given showing the normal modes of vibration. Many examples of molecules which are believed to possess certain of the structures are included in the tables, together with references to experimental papers dealing with them. AUTHOR.

3308. Molecular Spectra and Molecular Structure. H. Deslandres. *Comptes Rendus,* 198. *pp.* 2037–2041, *June* 11, 1934.—The ideas of the relationship between the spectrum of a molecule and the electrons and electron shells of the constituent atoms, described in a series of previous papers, are developed further and applied to the infra-red and Raman spectra of rock-salt, NO, and CH_4. [See Abstract 4331 (1932).] C. B. A.

3309. Intensities of Magnetic Dipole Lines. J. Blaton. *Zeits. f. Physik,* 89. 3–4. *pp.* 155–165, *May* 24, 1934.—A mathematical paper, in which the selection rules and intensity equations for magnetic dipole radiation are derived and are applied to the $^1S \rightarrow {}^3P$ and $^1D \rightarrow {}^3P$ transitions in the p^2 configuration. In the case of the transition associated with mixed radiation the calculated intensities are greater than the total intensities calculated by Stevenson, whereas for the $^1S_0 \rightarrow {}^3P_1$ transition, which yields solely magnetic dipole radiation, lower values than Stevenson's are obtained. H. F. G.

3310. Demonstration of the Existence of Dipolar Magnetic Radiation. H. Niewodniczański. *Comptes Rendus,* 198. *pp.* 2159–2161, *June* 18, 1934.—The author recently attributed four forbidden lines in the spectrum of PbI to transitions between atomic states having the same electron configuration $6s^2\ 6p^2$. These transitions cannot be due to normal electric dipole radiation. One of them, λ4618 ($^3P_1 - {}^1S_0$) cannot be due to quadripole radiation either. It might be due to magnetic dipole radiation. If so, it should give the reverse transverse Zeeman effect to that normally observed. To settle this point Pb vapour to which A was added was excited in the electrodeless discharge. The Zeeman effect observed was exactly that to be expected if the line is due to magnetic dipole radiation. This experiment is claimed as the first demonstration of the existence of such radiation. A. C. M.

3311. Absorption Spectrum of Rubidium in an Electric Field. Ny Tsi-Zé and Choong Shin-Piaw. *Comptes Rendus,* 198. *pp.* 2156–2159, *June* 18, 1934.—Light is passed through an absorption tube containing Rb vapour, in which a parallel-plate condenser is placed. When an electric field is applied to the plates (303 volts per cm. in one experiment) the principal series is curtailed, and between lines of the series appear pairs of lines, normally forbidden, belonging to S — S and S — D transitions. The earliest lines of the S — mS series is 5S — 16S, and of the other, 5S — 13D. The lines get stronger as this increases. The applied potential difference was increased up to 1820 volts per cm., and the general character of the observations was unaltered. A. C. M.

3312. Raman Spectra of Paraffins. K. W. F. Kohlrausch and F. Köppl. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 209–237, 1934.—Raman spectra are determined for the unbranched paraffins from propane to dodecane and also for cyclopropane, iso-butane and tetramethylmethane. In as far as the theories have been worked out, it is shown that the central force system is incapable of explaining the observed results and that the valency force system is only successful when there is no branching. The frequencies of the carbon chain do not exceed 1100 cm.$^{-1}$; frequencies higher than this must be ascribed to deformation CH vibrations. The C — C valency force constant decreases with increase of branching. The spectra of the unbranched paraffins from pentane to dodecane show great regularity and simplicity. They have a deformation frequency and a valency frequency, the former of which decreases regularly with increase of chain length, while the latter alternately decreases and increases for the even and odd numbers of carbons. An attempt is made to ascribe certain frequencies to certain forms of oscillation and attention is drawn to the difficulties encountered in comparing the experimental findings with the deductions from symmetry considerations. L. A. W.

3313. Raman Spectrum of Carbon Disulphide. A. Langseth, J. U. Sørensen and J. R. Nielsen. *J. Chem. Phys.* 2. *pp.* 402–409, *July*, 1934.—The Raman spectrum of liquid CS_2 has been investigated with high dispersion. In addition to the lines already known, five very faint lines have been observed. The intensities of the stronger lines were measured and, with a spectrograph of low dispersion, the degrees of depolarisation of the two principal bands were determined. The results are in accord with the assumption made by Fermi, Dennison and Placzek that large perturbations of some of the energy levels occur on account of the approximate coincidence of ν_1 with $2\nu_2$. The values $\Delta = -120$ cm.$^{-1}$ and $|\mathrm{P}| = 17\cdot8$ cm.$^{-1}$ are obtained for the difference $\Delta = \nu_1 - 2\nu_2$ and for the coupling constant $\mathrm{P} = \beta h^{\frac{1}{2}}/4\pi^2\mu_1^{\frac{1}{2}}\mu_2(\nu_1 + 2\nu_2)^{\frac{3}{2}}$. AUTHORS.

3314. Raman Spectra and Organic Chemistry. K. W. F. Kohlrausch. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 429–434, *July*, 1934.—An account is given of the application of Raman spectra to the elucidation of the structure of organic molecules. At the present time, insufficient is known of inner-molecular fields of force to make it possible to relate molecular properties to their spectroscopic effects without some ambiguity so that, in particular for polyatomic molecules, it is necessary to compare the spectra obtained from known and systematically variable configurations in order to establish empirical relationships. The results of such investigations are collected together for a number of special cases, including the molecules HX and H_3CX, H_2CX_2 and HCX_3 ($X = CH_3$, Cl, Br or I), the normal paraffins and their monosubstituted derivatives, the spectrum of the $C - X$ bond (where $X = SH$, Cl, Br, or I), the $> C = O$ group, and keto-enol, ketamide-enamine, and cis-trans isomerism. C. B. A.

3315. Constitution of Water in Different States. I. R. Rao. *Roy. Soc., Proc.* 145. *pp.* 489–508, *July* 2, 1934.—The Raman bands for ice and water at 0°, 4°, 38°, and 98° C. are taken and their intensity distribution with respect to wave-length determined. The general appearance of the intensity curves is found to indicate that each of them is due to superposition of three components, which are attributed to the single, vapour molecules, double, water molecules, and triple, ice molecules, respectively. Each of the intensity curves is analysed into the three components and from the intensities of the components the relative proportions of the ice, water and vapour molecules are calculated. The changes in H_2O from one state to another are explained from the above results. AUTHOR.

3316. Wire Grating Spectrometer for the Far Infra-Red. R. B. Barnes. *Rev. Sci. Instruments*, 5. *pp.* 237–243, *July*, 1934.—A spectrometer of new design is described, which makes easier the investigation of the far infra-red spectra of either solids, liquids or gases. With this instrument a very high degree of resolution has been obtained and several substances have been studied from 30μ to 180μ. From 30μ to 85μ the effective slit-width was 1·04μ; from 85μ to 122μ, 1·67μ; and from 122μ to 180μ, 2·59μ. AUTHOR.

3317. Limits of Sensitivity of the Spectroscopic Detection of Cadmium and Palladium in Silver. G. Baiersdorf. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 1–2. *pp.* 19–29, 1934.—The limits of sensitivity are very largely dependent upon the method of excitation adopted. The values observed are: cadmium, below 10^{-4} (spark), below 10^{-7} (arc); palladium 10^{-5} (arc), 10^{-6} (arc) when the polished surface is first etched with dilute nitric acid to concentrate the palladium in the surface.
H. F. G.

3318. Quantitative Spectral Analysis. Part II. R. Breckpot and A. Mevis. *Ann. Soc. Sci. de Bruxelles,* 54. *pp.* 99–119, *June* 16, 1934.—A continuation of previous work [see Abstract 1619 (1934)]. The quantitative determination of Cd, Sn, Zn, Al, Ba, Ca, Mg, Ge, and Au, present in Cu is described. Most of the above metals can be estimated in concentrations of 0·001 %. Comprehensive tables are given showing the principal lines and the accuracy obtainable. W. R. A.

See also Abstracts **3083, 3189, 3190, 3253, 3264, 3348, 3355, 3356, 3369, 3372, 3373, 3393.**

VELOCITY OF LIGHT.

3319. Velocity of Light. M. E. J. G. de Bray. *Nature,* 133. *pp.* 948–949, *June* 23, 1934.—The author claims that the determinations of the velocity of light during the period 1870–1934, show that this velocity fluctuates according to a sine law. G. C. McV.

VISION.

3320. Hue Sensitivity of the Eye at Different Brightnesses and Saturations. Construction of a Sensitive Colour Pyrometer. G. Haase. *Ann. d. Physik,* 20. 1. *pp.* 75–105, *May,* 1934.—Measurements of the hue discrimination threshold throughout the spectrum at constant brightness were made, at brightness levels from 0·048 to 4800 apostilbs (1 asb = approx. 3×10^{-5} c/m.^{2}). Save at the lowest and highest brightnesses, the hue sensitivity was little affected by the brightness level. Similar measurements in which both sides of the photometer field were desaturated by the addition of white showed a decrease in hue sensitivity only when the proportion of white exceeded 50 % (in the blue end, 400 to 480 $m\mu$, no decrease was observable even at 75 % white content). The data obtained are used in the design of a colour pyrometer in which four light pencils from the radiator are passed through appropriate colour filters, the lights then being mixed in two pairs and presented to the observer in a bipartite matching field. Wedges in the several light beams enable a brightness and colour match to be made, and from the setting of the wedges the temperature of the radiator is determined. Under optimum conditions, the sensitivity of the instrument is estimated at 2·5° C. at 1500° K. W. S. S.

3321. Method of Locating Retinal Impressions with Respect to the Fovea. Application to the Study of Visual Acuity at Low Brightnesses. E. Haas. *Comptes Rendus,* 198. *pp.* 1878–1879, *May* 23, 1934.—The subject fixates on the centre of a cross formed by two lines of small apertures illuminated to a high brightness (1000 c./cm.^{2}). The after-image, which persists some 12 min. after removal of the stimulus, then serves as a system of coordinates in which subsequent visual sensations can be located. Using this method, an experiment was made showing that at a brightness of 2×10^{-6} c./cm.^{2} visual acuity is maximal at the fovea. W. S. S.

3322. Colour Vision. Part I. Adjustment of the König Values. Part II. Effect of the Eye Media on Colour Perception. E. Haschek. *Akad. Wiss. Wien, Ber.* 143. 2*a.* 1–2. *pp.* 71–78, and 143. 2*a.* 3–4. *pp.* 99–108, 1934.—Accepting the *Grundempfindungen* values given by König as a substantially correct representation of the excitation properties of the three mechanisms of colour vision, at least for König's own eye, the author applies certain corrections to the data, so that the form of the spectral locus in the colour triangle satisfies several general conditions. In Part II, the known fluorescence and absorption of the eye lens and an assumed red fluorescence (due to excitation in the blue or ultra-violet) of a layer near the retina, are used to explain the colour effects obtained at the blue end of the spectrum. Allowing for these effects the true *Grundempfindungen* of the receptor elements probably differ from the König curves in not showing a secondary maximum for the red curve and in giving a blue curve extending well into the ultra-violet. W. S. S.

X-RAYS.

3323. Device for Moving the Focal Spots of X-Ray Tubes. J. Obrist. *Zeits. f. techn. Physik,* 15. 6. *pp.* 236–238, 1934.—Full constructional details are given of a device, based on an earlier one of Zeeman, for controlling the direction of the beam in a discharge tube. The apparatus is adapted to be fitted on to a demountable X-ray tube. The use of soft metal on the joints in place of rubber, eliminates the difficulties of evacuation caused by the evolution of vapours from the rubber. J. E. R.

3324. Discharge Rays. G. Reboul. *J. de Physique et le Radium,* 5. *pp.* 287–288, *June,* 1934.—The author replies to Dauvillier's criticism of his work on this subject [see Abstract 2921 (1934)]. Attention is directed more especially to the ionising character of the radiation. J. S. G. T.

3325. Limits of Validity of the Klein-Nishina Formula. M. Bronstein. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 517–522, 1934. *In German.*—By applying the correspondence principle to the condition $\lambda \gg e^2/mc^2$ (wave-length of radiation much larger than the classical electron radius) in the case of scattering of radiation by an electron originally at rest, Bohr found the Klein-Nishina formula to remain valid if $h\nu \ll (hc/e^2)^2 mc^2$, *i.e.* up to energies of the incident light quant of more than 10^{11} electron volts. When, however, intermediate quantum states are considered in which either the electron has acquired the momentum of the incident photon and has not yet emitted the scattered photon, or has emitted the scattered photon while the incident photon is still in the field, the condition for the validity of the formula becomes more stringent and $h\nu$ must be considerably less than 10^7 electron volts. It appears, therefore, that the Klein-Nishina result is inapplicable in the domain of cosmic rays. W. S. S.

3326. Calculation of Mass Scattering Coefficients. L. M. Heil. *Phys. Rev.* 46. *pp.* 58–62, *July* 1, 1934.—By means of graphical integration, the mass scattering coefficients of the substances carbon, aluminium, iron, tin and gold have been calculated over the wave-length range 0·4 Å to

1·1 Å. The results show: (1) the mass coefficients obtained agree reasonably well with those obtained experimentally by Coade, Mertz, Hewlett, Statz and Allen; (2) the mass scattering coefficients may be expressed by the relation, $\sigma/\rho = 0\cdot0230Z^{1\cdot16}\lambda$, over a wave-length range 0·4 Å to 1·1 Å and upwards from atomic number 12; (3) the part of the scattering coefficient due to incoherent scattering averages 20 % lower than that value expressed by the Dirac or the Klein-Nishina formula.

AUTHOR.

3327. X-Ray Emission Spectrum and Chemical Combination. Part III. K$\alpha_1\alpha_2$ Doublet of Sulphur in Various Sulphides. O. Lundquist. *Zeits. f. Physik*, 89. 5–6. *pp.* 273–276, *June* 2, 1934.—In completion of a previous investigation on the K$\alpha_1\alpha_2$ doublet of sulphur in various compounds the results of measurements for a larger number of sulphides are given. A slight influence of the chemical binding on the position of the doublet can be observed. The sulphides investigated were MgS, Al_2S_3, CaS, FeS, NiS, Cu_2S, CdS, SnS_2, Sb_2S_3, and BaS, in addition to Cr_2S_3, CuS, ZnS, and Ag_2S previously examined. [For Part II see Abstract 3653 (1933).] J. J. S.

3328. Influence of a Magnetic Field on the Diffraction of X-Rays by Liquids. H. Sirk. *Zeits. f. Physik*, 89. 3–4. *pp.* 129–142, *May* 24, 1934.—Debye-Scherrer rings from α-chlornaphthalin are measured photometrically. The X-ray photographs are taken with the liquid under the influence of a strong magnetic field of 4 × 10^4 gauss but no indication of fibre-structure is observed. The limit for the number of molecules in a group is given as 10^4. J. T.

3329. Convenient X-Ray Vacuum Camera for Low Temperatures. E. Pohland. *Zeits. f. phys. Chem.* 26. *Abt.B.* 3. *pp.* 238–245, 1934.—Previously described experimental arrangements for X-ray exposures at low temperatures have various shortcomings. A description is given of a new type of vacuum camera, easy to construct and convenient to manipulate, in which the film and the substance under investigation are housed in separate compartments. L. A. W.

3330. X-Ray Wave-Lengths from Crystals and Ruled Gratings. A. E. Ruark. *Phys. Rev.* 45. *pp.* 827–831, *June* 1, 1934.—Energies of photoelectrons ejected by X-rays from thin foils have been measured by Kretschmar and by Robinson and his colleagues, using the magnetic spectrograph. Their values are compared with those computed from wave-lengths of the incident rays and X-ray terms of the atoms in the foils, using (*a*) wave-lengths measured with crystals, based on the actual calcite spacing rather than the conventional one; (*b*) ruled grating wave-lengths, which are higher by 0·25 %. Using Birge's value of *e*, 4·7668 × 10^{-10} e.s.u., Bearden's value for the calcite spacing becomes (3027·91 ± 1·0) × 10^{-11} cm. To get photoelectron energies from crystal wave-lengths, accurate X-ray terms are worked out by a new plan, which avoids uncertainties involved in using absorption-edge wave-lengths. Term differences are obtained from X-ray line spectra, and are added to the value of some low term obtained from optical spectra. Birge's values of universal constants are employed in getting photoelectron energies. These energy values average 0·36 % higher than those computed from crystal wave-lengths, or 0·61 % higher than those from ruled-grating wave-lengths. This fact supports, but does not conclusively prove, the correctness of crystal wave-lengths based on the actual calcite grating space. AUTHOR.

See also Abstracts 3084, 3255, 3258, 3345, 3365, 3374, 3408, 3421, 3425.

HEAT.

CALORIMETRY.

3331. Rotational Specific Heats of HD and D_2 Molecules, and the Nuclear Spin of the D-Atom. K. Clusius and E. Bartholomé. *Zeits. f. Elektrochem.* 40. 7*b*. *pp.* 524–529, *July*, 1934.—The rotational specific heats of HD between 35° K. and 70° K. and of D_2 between 35° K. and 117° K. have been measured. HD has the rotational specific heat of a diatomic rotator with a maximum of 2·18 cal. for C_{rot} at 52° K. At room-temperature, D_2 contains two molecular types—2 parts ortho to 1 part para. It shows a maximum of 2·21 cal. at 92° K. The nuclear spin of the D nucleus is 1. Rotation quanta and molecular states are tabulated. The lowest state in ordinary hydrogen is associated with the para form: in D with the ortho form. The atomic separations in H_2, HD and D_2 are equal within 3 %. By rapid cooling from 1000° to room-temperature, the equilibrium $2HD \rightleftarrows H_2 + D_2$ can be frozen. It is not affected by further slow cooling to low temperatures. The equilibrium D_2(ortho) $\rightleftarrows$ D_2 (para) is also completely frozen at low temperatures. C. B. A.

3332. Specific Heat of Nickel and of Nickel-Copper Alloys. K. E. Grew. *Roy. Soc.*, *Proc.* 145. *pp.* 509–522, *July* 2, 1934.—The specific heat of pure nickel and of three alloys of copper with nickel (94·0, 87·2, 78·8 % nickel respectively) has been measured over a temperature range from − 180° to 450° C. An electrical method was used in which the specimen was heated by the effect of its own resistance, the temperature change being measured by means of a thermocouple attached to the specimen. The specific heat S_1 due to the intrinsic magnetisation was calculated. The value of the molecular field constant N which is involved in the calculation was taken to be the same as that determined from susceptibility measurements in the paramagnetic state. The existence of a second term S_2 in the excess specific heat S must then be assumed, since S_1 accounts for only a part of S. Although the values of S and S_1 are not known with much precision, it appears that the change in S at the Curie point in the alloys can be explained quantitatively by the disappearance of the term S_1, as for pure nickel and iron. The value of S above the Curie point, regarded as a function of the composition of the alloys, probably becomes zero when the saturation moment becomes zero. This suggests that the second term S_2 has a common origin with the ferromagnetism. AUTHOR.

3333. Errors in Bomb Calorimetry with Commercial Oxygen. L. J. P. Keffler. *Am. Chem. Soc.*, *J.* 56. *pp.* 1259–1262, *June*, 1934.—The accuracy of the water value of a calorimetric bomb, and of determinations made thereby are liable to appreciable error through the presence of combustible impurity in the oxygen, and the concentration of the impurity may vary with the pressure of the gas in the cylinder. It is suggested that the variation in the apparent value of the water-equivalent with this pressure may be governed by Graham's law of effusion. In high precision experiments the error may be eliminated by initial purification of the O_2 by preheating, and by alternate repeated calibrations and determinations. N. M. B.

See also Abstracts 3080, 3085, 3331, 3359.

CONDUCTION.

3334. Calculation of the Surface Temperature of Simple Bodies. S. Goldstein. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 158–162, *June,* 1934. *In English.*—If a is the thermometric conductivity and h the relative emissivity, simple formulæ are given for the surface temperature, ϑ_0, of (1) an infinite slab of thickness $2l$, (2) an infinite cylinder of radius R, (3) a sphere of radius R, which, at time $t = 0$, is at unit temperature and is placed in a medium at temperature zero, into which radiation takes place from the surface. The formulæ apply when at/l^2 or at/R^2 is small, when the usual solution as an infinite series converges very slowly. The formulæ are $\vartheta_0 = f_1(\eta)$ for the slab, $= f_1(\eta) + \frac{1}{2\gamma} f_2(\eta)$ for the cylinder, $= f_1(\eta) + \frac{1}{\gamma} f_2(\eta)$ for the sphere, where $f_1(\eta)$ and $f_2(\eta)$ are given in an equation, erf η, γ and η being also defined in other equations. Some numerical values are given for comparison with values calculated from the series by G. Pöschl [see Abstract 286 (1933)]. AUTHOR.

3335. Friction, Heat Conduction and Diffusion in Gaseous Mixtures. Parts XXV-XXVIII. M. Trautz, R. Heberling, I. Husseini, F. Ruf and A. Freytag. *Ann. d. Physik,* 20. 2. *pp.* 118–144, *June,* 1934. —Continuing a previous research [see Abstract 701 (1934)] a transpiration method is employed to measure the viscosities of Xe, and of its mixtures with H_2 and He (Part XXV); and of six hydrocarbons and their mixtures with H_2 and He (Part XXVI), from 290° to 550° C. By an alternative method the viscosities of Cl_2 and HI are measured over the same range, partly as a test of the method (Part XXVII), while in Part XXVIII, the viscosities of Cl_2, NO and NOCl, and of the gas during the reaction $2NO + Cl_2 = 2NOCl$, are determined. In all cases the requisite constants for the general empirical formula are calculated from the results, and in Parts XXVII and XXVIII, the molecular diameters and related quantities worked out. J. P. A.

3336. Thermal Conductivity of Air by a Parallel Plate Method. E. O. Hercus and D. M. Sutherland. *Roy. Soc., Proc.* 145. *pp.* 599–611, *July* 2, 1934.—The thermal conductivity of dry air at 20° C. at atmospheric pressure has been determined on the general lines of the method used by Hercus and Laby [see Abstract 455 (1919)] but with an allowance for radiation by the use of two plate distances and with improved thermocouple technique and greater steadiness of conditions during the observations. The value found from a series of 10 experiments at each of two distances was $6{\cdot}06 \times 10^{-5}$ with a probable error of $\pm 0{\cdot}04 \times 10^{-5}$. Using a temperature coefficient of $0{\cdot}00298$ per ° C., this reduces to a value at 0° C. of $5{\cdot}72 \times 10^{-5}$, a result in good agreement with hot-wire determinations. AUTHORS.

3337. Thermal Conductivity of Silica Aërogel. S. S. Kistler and A. G. Caldwell. *Indust. and Engin. Chem.* 26. *pp.* 658–662, *June,* 1934.—Silica aërogel is made by forming a jelly with water glass and acid, washing to remove excess acid and salts, replacing the water in the gel with alcohol and liberating the alcohol, as vapour, in an autoclave. The final product retains its jelly submicrostructure but is a mass of very minute air-cells and has an apparent density of 0·1. In the powder form it will withstand a load of 30 lb. per sq. in. without crushing. An apparatus is described in which the thermal conductivity of silica aërogel powdered to various degrees of fineness has been measured at a temperature of about 35° C. under variable mechanical and air pressures. It is found to possess the lowest thermal conductivity yet reported for any insulator at atmospheric pressure. The average value for the aërogel powder is 10 % less than that for air. A 30 % decrease is effected by replacing the air in the gel by dichlorodifluoromethane, while the conductivity *in vacuo* is only 15 % of normal. The low conductivity can be explained by the air-cells in the gel being so small that the mean free path is restricted to a smaller value than that in air, and a theory is derived based on this assumption. R. W. P.

3338. Preparation of Specimens for the Measurement of Thermal Conductivity. J. M. Adams. *Rev. Sci. Instruments*, 5. *pp.* 250–252, *July*, 1934.—The paper describes an exactly reproducible method of applying metallic coatings to the surfaces of solid specimens and of imbedding thermocouples precisely at any given depth in the coatings. The method makes possible the complete elimination of the variable discontinuity of temperature which is always present, to a greater or less degree, in measurements of thermal conductivity, between the specimen and the metallic surfaces in contact with it. A new technique for the stripping of fine silk-covered wires is described. AUTHOR.

3339. Thermal Diffusivity of Poor Conductors. E. D. van Rest. *Phys. Soc., Proc.* 46. *pp.* 537–544 ; *Disc.*, 544, *July* 1, 1934.—A new method of determining the thermal diffusivity of poor conductors is described. An irregularly shaped block may be used provided that it has a fairly large plane surface. Temperature observations are made at two points within the block either by embedding thermocouples or by inserting them between cut surfaces. Small temperature-intervals (less than 10° C.) are used and considerable liberty of experimental conditions is afforded. Only a distance and quantities proportional to the temperature changes at the two points need be measured. The method has been developed for use with wood, but results are given for a block of cast sulphur and several other common materials. AUTHOR.

See also Abstract 3340.

CONVECTION.

3340. Precision Measurements of Natural Convection. A. Potop. *Comptes Rendus*, 198. *pp.* 1847–1849, *May* 23, 1934.—The method of determining the thermal conductivity of a wire by measuring the loss of heat when a current is passed through the wire fitted into a radiator has been studied. The condition of the silver radiating surface is immaterial for temperatures below 100° C. The radiator is fitted rigidly inside a heavy metal container of which the temperature determines the convection loss. The behaviour of the system is governed by the absolute temperatures of the radiator and container, and not by the difference between these temperatures. There is never an absolutely permanent state. Under suitable conditions the energy dissipated (0·5 watt) is reproducible to within 0·0001 watt. H. F. G.

3341. Electric Furnaces. C. Rigollet. *J. de Physique et le Radium*, 5. *pp.* 262–266, *June*, 1934.—A study is made of the loss of heat from furnaces of the electric resistance type and Fourier's theory is applied to show the effect on the heat losses of the thickness of the furnace walls. Points of practical interest are briefly discussed and an account is given of a method of obtaining in a furnace a linear increase of temperature with time. This method has proved very useful in a study of thermal decompositions.

A. W.

DILATATION.

3342. Thermal Expansion of Alloys of Cobalt, Iron and Chromium, and a New Alloy "Stainless-Invar." H. Masumoto. *Tohoku Univ., Sci. Reports,* 23. *pp.* 265–280. *May,* 1934. *In English. Report No.* 323 *from the Research Inst. for Iron, Steel and other Metals.*—The author has measured the thermal expansion of ternary alloys of Co, Fe and Cr, and has found that an addition of a small quantity of Cr to Co-Fe alloys containing more than 50 per cent of Co considerably reduces their expansibility. The measurement of the thermal expansion of alloys having small expansibility was made from the temperature of liquid air to the vicinity of the magnetic transformation point, and the range of temperature available for this small expansibility was examined. The smallest coefficient of linear expansion at 20° found in the present investigation was $-1\cdot2\times10^{-6}$. Further, it was found that alloys having small expansibility were practically incorrodible in dilute solution of NaCl. Some physical properties of these alloys were also determined.

AUTHOR.

See also Abstracts **3134, 3343, 3359.**

MELTING AND BOILING POINTS.

3343. Theory of Melting, Recrystallisation and Polymorphic Transformation Temperatures. L. Tarschisch. *Phys. Zeits.* 35. *pp.* 469–471, *June* 15, 1934.—The simple relation $T'_s/T_s = (R_0/R'_0)^n$ is shown to exist between the melting point, T_s, and the atomic distance at absolute zero, R_0, n being a constant for the particular substance. It thus becomes possible to construct the phase diagram for certain solid solutions from X-ray measurements of the lattice constant. A similar relation also applies for polymorphic transformation temperatures and an expression is deduced which shows that the probability of the occurrence of recrystallisation is also a function of R_0/R'_0.

R. W. P.

See also Abstract **3359.**

TEMPERATURE, MEASUREMENT OF.

3344. New Types of Linear Bolometers. R. C. L. Bosworth. *Faraday Soc., Trans.* 30. *pp.* 554–560, *July,* 1934.—Nickel strips have been prepared and used in the construction of different types of bolometers. The arms being much thinner than the Lummer and Kurlbaum type, the bolometers are approximately twice as rapid in their action. Further, being self-supporting, they are very sensitive—up to twenty times the intrinsic sensitivity of a Kipp linear thermopile being obtained. Straight and differential types of bolometers have been constructed and examined. A very simple type of bolometric relay is described, which is twice as effective as a copper-oxide photoelectric-cell. Finally two devices are described for further increasing the sensitivity of the bolometer; one, a regenerative device, increases the damping on the galvanometer; and the other, a compensated valve-bridge amplifier, reduces the damping. AUTHOR.

3345. Safety Device for Water-Cooled Apparatus. H. Beck. *Zeits. f. techn. Physik*, 15. 6. *pp.* 221–223, 1934.—A simple apparatus is described for securing a steady flow of water. The flow is regulated by means of a simple valve and the weight of water in a small container in the path of the flow serves as a deflecting force on one arm of a lever system, which is kept balanced by means of a simple tilting switch. The application of the apparatus to a water-cooled X-ray outfit is described. H. J. H. S.

See also Abstracts 3134, 3320, 3334.

THERMOCHEMISTRY.

3346. Heat of Dilution of Salts. (Miss) M. Quintin. *Comptes Rendus*, 198. *pp.* 1856–1858, *May* 23, 1934.—A method of calculating the heats of dilution of salts from e.m.f. data is given, and the values are calculated from published data relating to cupric sulphate for concentrations from zero to 0·525 *M*. The curve showing the relation between the partial molar heat of dilution and the square root of the concentration is in accordance with the Debye theory, except that it passes through a point of inflexion at high dilutions. H. F. G.

3347. Heats of Dilution of Completely Dissociated Electrolytes. O. Gatty. *Phil. Mag.* 18. *pp.* 46–63, *July*, 1934.—An apparent paradox in the theory of heats of dilution of electrolytes that obey the Debye-Hückel formulæ is investigated. A number of terms become small in dilute solutions in proportion to the square root of the concentration and others become small in proportion to the concentration. The various heat and volume changes on dilution and on discharging the ions are classified according to which of the above classes contains them. The methods here developed are applicable to the general problem of molecular interaction and not merely to the fields of force round electrically-charged ions. AUTHOR.

3348. Free Energy of Sulphur Monoxide and the Dissociation Constants of S_2. C. W. Montgomery and L. S. Kassel. *J. Chem. Phys.* 2. *pp.* 417–418, *July*, 1934.—Values of $(F^0 - E_0{}^0)/T$ are calculated from spectroscopic data for S_2, SO and S, and equilibrium constants obtained for the reactions $2SO = S_2 + O_2$; $2SO = \frac{1}{2}S_2 + SO_2$; $S_2 = 2S$. It is found that SO is stable with respect to the first mode of decomposition, but unstable with respect to the second except at higher temperatures. AUTHORS.

3349. Velocity of Explosion of Solid Explosives. R. Schwob. *Comptes Rendus*, 198. *pp.* 1990–1992, *June* 4, 1934.—The relation $V = 1/(m - n\Delta^{\frac{1}{2}})$, where V is the velocity of detonation, Δ density of loading, and m and n are constants, is deduced, and shown to be accurate within 2·8 % for $\Delta = 0 \cdot 25 - 1 \cdot 5$ for melinite, nitrohexanol, tetryl, and tetranitropentaerythrite. It gives values of V slightly too high if Δ be $> 1 \cdot 5$. This is perhaps due to the air compressed in the interstices of the explosive. C. A. S.

3350. Luminosity of Shock Waves. A. Michel-Lévy and H. Muraour. *Comptes Rendus*, 198. *pp.* 2091–2093, *June* 11, 1934.—The luminous effects which accompany the detonation of lead azide vary with the nature of the gas through which the explosion wave is propagated. The temperature reached depends upon the gas. Experiments were carried out in A, N_2, H_2, CO_2, C_2H_2 and butane. Maximum luminosity was observed in A and least in C_2H_2 and butane. [See Abstracts 2567 and 2906 (1934).] A. S. C. L.

3351. Inflammability of H_2-O_2 Mixtures by Spark Discharge. A. L. Bestchastny, F. A. Lavrov and A. W. Sagulin. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 562–579, 1934. *In English.*—The critical ignition pressure of H_2-O_2 mixtures by spark-discharge is examined. The relationship of the critical pressure to the diameter of the reaction vessel and to the energy of the discharge is described. The decrease of the partial pressure of the explosive mixture under the influence of excess O_2 (or inactive gases) is shown. The whole region of ignition is displaced by the presence of inactive gases. AUTHORS.

See also **Abstracts 3077, 3333, 3370, 3437.**

THERMODYNAMICS.

3352. Possible Failure of Energy Conservation. R. C. Tolman. *Nat. Acad. Sci., Proc.* 20. *pp.* 379–383, *June,* 1934.—The author speculates on the possibility that there may be a breakdown of energy-conservation in the individual processes involved in the production of the continuous β-ray spectrum. He also shows under what circumstances conservation would break down in a statistical sense in an assembly where nuclei are disintegrating and emitting electrons whilst the reverse process is also going on. G. C. McV.

3353. Beattie-Bridgemann Equation of State. W. Jacyna, S. Derewjankin A. Obnorsky and T. Parfentjew. *Zeits. f. Physik,* 89. 5–6, *pp.* 370–372, *June* 2, 1934.—The equations of state derived by Beattie and Bridgemann [see Abstract 1247 (1929)] and by Huang and Su [see Abstract 3699 (1933)] are shown to be identical with the Jakob-Planck form $vp = RT - f(p, T)$. J. S. G. T.

3354. Specific Heat of Gases from Vapour Pressure Data. M. Trautz and H. Ader. *Zeits. f. techn. Physik,* 15. 6. *pp.* 239–246, 1934.—A means of determining the molecular heat of a gas over a wide range of temperature which is independent of calorimetric methods is derived and applied to the case of water vapour. Differentiation of the equation representing the ratio of the molecular heat of vaporisation (L) to the absolute temperature (T) as the difference between the entropies of one molecule of saturated vapour and one molecule of liquid at T° gives the following equation:— $C_d = \frac{dL}{dT} + C_l - \frac{L}{T} + T\frac{dp}{dT}\left[\frac{\partial(v_d - v_l)}{\partial T}\right]$, where p is the vapour pressure; C_d and C_l the molecular heats of the vapour and liquid and v_d and v_l the corresponding molecular volumes. The terms involving the latent heat are obtained in terms of vapour-pressure data by differentiation of the Clausius equation and the final expression becomes

$$C_d = C_l + T\left\{\frac{d^2p}{dT^2}(v_d - v_l) + \frac{dp}{dT}\left[2\cdot\frac{\partial(v_d - v_l)}{\partial T} - \frac{\partial(v_d - v_l)}{\partial p}\cdot\frac{dp}{dT}\right]\right\}.$$

Values of the various quantities are tabulated for water vapour using existing data. R. W. P.

3355. Heat Capacity Curves of the Simpler Gases. Part V. Entropy, Heat Capacity and Total Energy of Hydrogen. C. O. Davis and H. L. Johnston. *Am. Chem. Soc., J.* 56. *pp.* 1045–1047, *May,* 1934.—Calculations made from the spectroscopic data over the temperature range, 250 to 5000° K. A table is given of the distribution of

H_2 molecules among the various vibrational levels. The influence of anharmonic vibration is large in hydrogen and, at 5000° K, is about 0·5 cal./mol./° C. [For Part IV see Abstract 2113 (1934).] A. S. C. L.

3356. Heat Capacity Curves of the Simpler Gases. Part VI. Free Energy, Total Energy, Entropy, Heat Capacity and Dissociation of H^2H^2 and of H^1H^2, to 3000° K. H. L. Johnston and E. A. Long. *J. Chem. Phys.* 2. *pp.* 389–395, *July*, 1934.—Heat capacities, entropies, free energies, total energies and dissociation constants have been calculated for H^2H^2 and for H^1H^2, to 3000° K, by reliable methods and are listed in tabular form. The ortho-para equilibrium in H^2H^2 has been considered for both the gaseous and the solid states. The solid state equilibrium has been discussed from the point of view of its bearing on the application of the third law of thermodynamics. The rotational heat capacity curves of the various forms of H^2H^2 and that of H^1H^2 are shown graphically and are compared with the rotational heat capacity curve of H^2H^2 and with the hypothetical rotational specific heats of N^2. The heavy molecules, H^2H^2 and H^1H^2, dissociate to only about one-half the extent of H^1H^1 below 3000° K. The three hydrogen molecules are compared with respect to the influences of molecular stretching and of anharmonic vibration in the high temperature heat capacities. Tables are also included which show the distributions of molecules among the vibrational levels as a function of the temperature. AUTHORS.

3357. Affinities of Formation of Ag_2S, Ag_2Se and Ag_2Te by E.M.F. Measurements. H. Reinhold. *Zeits. f. Elektrochem.* 40. 7*a*. *pp.* 361–364, *July*, 1934.—The affinities of Ag for S, Se and Te were determined from the e.m.f. of cells, using an auxiliary electrolyte α-AgI. The compounds α-Ag_2S, α-Ag_2Se, and α-Ag_2Te were investigated. It is shown that the affinity can be directly measured with these solid compounds as they conduct electronically. The cells were made up on the general scheme: Ag/α AgI/α — Ag_2 X/X, where X denotes S, Se and Te. F. J. B.

3358. E.M.F. of the Cell: Ag/AgI/Ag_2S/Pt(+S). C. Wagner. *Zeits. f. Elektrochem.* 40. 7*a*. *pp.* 364–365, *July*, 1934.—The theoretical basis is developed for the determination of the formation affinity of Ag_2S from e.m.f. measurements. The cell discussed is Ag/AgI/Ag_2S/Pt(+S) with solid salts. F. J. B.

See also Abstracts 3079, 3107, 3156, 3163, 3213, 3217, 3446.

VAPOUR PRESSURE.

3359. Physical Properties of Cyclohexane. L. Rotinjanz and N. Nagornow. *Zeits. f. phys. Chem.* 169. *Abt.A*. 1–2. *pp.* 20–30, 1934.—Determinations have been made of the following physical properties of cyclohexane. Isotherms and isochores over the temperature range 2 to 300° C. and for pressures up to 200 atmospheres; the coordinates of the triple point (6·63° C. 40 mm. Hg.); density and specific volume of the liquid; vapour pressure and orthobaric volume of 1 gm. of liquid and vapour; latent heat of fusion; effect of pressure on the melting point; change of volume on melting. From the data the coordinates of the liquid-solid critical point are calculated to be about 100° C. and 2000 atmospheres pressure. It appears from an analysis of these results and those of Young for benzene that the surface states of cyclohexane and benzene are similar in the gas to liquid region but not in the liquid to crystalline. R. W. P.

See also Abstracts 3127, 3133.

ACOUSTICS.

3360. Theory of Sound in Voice Tubes with Radiating Walls. A. Press. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 616–634, 1934. *In English.*—To allow for radiation of energy through the walls of a tube a constant *k* is introduced which appears in the differential equation defining the non-stationary or non-conservative type of motion. Experimental methods are suggested for determining the value of the radiative coefficient *k*. This coefficient leads to progressive waves being set up along the tube walls. Similar effects have previously been shown to obtain for the voltage and current distributions along a radiating Hertzian aerial. A. W.

3361. Supersonic Dispersion in Gases. E. G. Richardson. *Roy. Soc., Proc.* 146. *pp.* 56–71, *Aug.* 1, 1934.—The propagation through various gases of supersonic radiation emitted by piezoelectrically maintained quartz crystals is examined experimentally. New methods involving the change of resistance of an electrically heated wire exposed to the radiation are developed, enabling the wave-length and amplitude of the gaseous vibration to be measured. The method of calibrating the apparatus is also described, and the results compared with those obtained by older methods. The anomalous dispersion and absorption shown by certain gases is critically examined, and suggestions put forward to account for it. Evidence is adduced to show that some of the radiation "absorbed" is scattered by the gas. AUTHOR.

3362. Interpretation of Vibro-Tactile Phenomena. R. H. Gault. *Acoustical Soc. of America, J.* 5. *pp.* 252–254, *April,* 1934—A discussion of the vibro-tactile sense and its education and development, especially as a means of communicating with the deaf. Among a very great number of patterns of amplified vibration that correspond to forms of speech and music, discriminations can be made with a high degree of success when stimuli are applied only to the finger surface. A well-trained deaf or hearing subject will detect a vibratory stimulus against his vibro-tactile organs that the untrained, especially the untrained hearing subject, is wholly unable to discover. G. E. A.

3363. Acoustic Threshold Values. W. Geffcken. *Ann. d. Physik,* 19. 8. *pp.* 829–848, *May,* 1934.—The threshold values of the stimuli for aural perception were determined from two independent series of measurements of threshold pressures and membrane impedance. The threshold pressures were obtained by use of the thermophone, the theory of which was improved in a previous paper [see Abstract 1982 (1933)]. Tröger's method was used to determine the membrane impedance. The sensitivity of the ears of the observers was of the order of magnitude of 10^9–10^{10} cm.^{2}sec./erg within the frequency range 300–2200 ∼. Marked variations of sensitivity from a mean curve were observed. In the case of one observer the sensitivity for a particular frequency was so high that the limit of spontaneous air pressure variations was nearly reached. The results obtained are discussed in relation to Wien's results and to the resonance theory of hearing. A. W.

See also Abstracts 3131, 3429.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts **3371, 3400, 3401.**

CONDUCTION AND DISCHARGE IN GASES.

3364. Ionisation at High Pressures. G. Harig. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 637–640, 1934. *In English.*—Jaffé's theory of columnar ionisation [see Abstract 2565 (1929)] is applied to the variation of ionisation with pressure. The deductions are compared with the experimental work of Bowen [see Abstract 4394 (1932)] on γ-rays. Good agreement is found between the calculated and observed values except at low voltages and high pressures. In the latter case the observed values are higher than the calculated but the discrepancy cannot with certainty be said to have a physical basis until the individual ion constants contained in the formula are separately known. F. C. C.

3365. Application of Laws of Similarity to Streaming of Electricity in Gases Ionised by X- and γ-Rays. A. Knaffl. *Akad. Wiss. Wien, Ber.* 143. 2*a*. 1–2. *pp.* 45–70, 1934.—The theoretical results deduced by Mache [see Abstract 2087 (1932)] for the streaming of electricity in ionised gases were experimentally verified for the case of a long cylindrical condenser, the ionisation of the gas being produced by X- and γ-rays. Results obtained by Seemann for the case of a plate condenser were also confirmed. A. W.

3366. Dielectric Strength of Air at H.F. F. Müller. *Arch. f. Elektrot.* 28. *pp.* 341–348, *June* 7, 1934.—Using 10-mm. dia. spheres the breakdown of air is investigated at atmospheric and lower pressures over a wave-length range of 340 m. to 12 m. At a critical wave-length a reduction of about 20 % is observed in the breakdown voltage. With wave-lengths less than 50 m. the dielectric strength is found to increase until at 12 m. the value is approximately that at 50 ∼. This phenomenon, which is also observed at low pressures, is explained in terms of electrode space charges. An increase of the spark lag is recorded at the higher frequencies. A. J. S.

3367. Arcs in Inert Gases. Part II. G. E. Doan and A. M. Thorne. *Phys. Rev.* 46. *pp.* 49–52, *July* 1, 1934.—Arcs in *pure* inert gases between electrodes of pure metals have been found impossible to maintain under ordinary conditions, whereas they are easy to maintain if the gas is slightly contaminated. (1) For highly purified iron in argon, helium and neon, and highly purified silver and zinc in argon, the arc discharge is inherently unstable. The kathode spot darts rapidly up and down the electrode, and finally goes out at values of open circuit voltage, short circuit current, pressure of the arc atmosphere, and electrode separation at which a stable arc is ordinarily obtained when slightly less pure elements are used. We conclude, therefore, that the degree of purity of the elements of metallic arcs in inert gases, and particularly the degree of purity of the gas, determines the boundaries within which stable arcing may occur. Further, for elements of a high degree of purity the boundary values of the region of unstable operation are quite definite and readily determinable experimentally; beyond these boundaries much more stable arcs are encountered. (2) The extinction of an unstable arc is not characterised by any marked change in the current or voltage of the arc at the instant immediately preceding extinction. (3) Higher purity of the electrode material and of the inert atmosphere appears to move the voltage *versus* current curve in the direction of higher voltage. [See Abstract 3395 (1932).] AUTHORS.

3368. Ionising Action of Slow Kathode Rays. H. Pigge. *Ann. d. Physik,* 20. 3. *pp.* 233–249, *June,* 1934.—The ionising action of slow kathode rays in nitrogen is investigated and the mean value of the ionisation energy, ϵ, per pair of ions determined. Contrary to what is found to be the case with swift-moving electrons, ϵ is found to be not constant but increases from the value 35·3 volts for 3·0 kV electrons to the value 42·5 for 0·3 kV. electrons. J. S. G. T.

3369. Energy of Excitation of Metastable Nitrogen. W. Weizel and H. Fischer. *Zeits. f. Physik,* 89. 5–6. *pp.* 283–285, *June* 2, 1934.—The energy of excitation of the metastable $^3\Sigma$ term of the nitrogen molecule is determined by the method of "excitation dispersion" as used by Lau and Reichenheim. A value 6·1 ± 0·5 volt is obtained, *i.e.,* 1·9 volt lower than that previously accepted. C. B. A.

3370. Ionisation Potentials and Energies of Formation of Non-Polar Molecules. Part III. J. Savard. *J. de Physique et le Radium,* 5. *pp.* 283–286, *June,* 1934.—The following molecules, O_2, HBr and Br_2, HI and I_2, H_2O, NO and NO_2, N_2O, NH_3, and $ZnCl_2$, whose ionisation potentials are not directly derivable from the author's formula [see Abstract 1268 (1934)] have been studied from the standpoint previously adopted (*loc. cit.*). The validity of the principles formerly proposed has been confirmed even for molecules possessing a feeble ionisation potential. Further, the validity of the principle of compensation is established, since it has verified that the energy of the repulsion exercised between the two nuclei of the molecule H_2 is equal to the difference between the ionisation potentials of the ion H_2^+ and the normal molecule. H. H. Ho.

3371. A.C. Method of Determining Critical Potentials. R. W. Hickman. *Physics,* 5. *pp.* 185–191, *July,* 1934.—An investigation of an a.c. bridge method of measuring critical potentials in a vapour has been made. The tube containing mercury vapour and of similar structure to that used in the experiments of Franck and Hertz was placed in one arm of an impedance bridge and so arranged that a small alternating voltage in series with a small direct retarding voltage existed between the accelerating grid and collecting plate. Measurements of the equivalent variational plate resistance and reactance were made as the steady accelerating voltage was varied. Plots of the variational resistance or reactance, or the bridge balancing resistance or capacitance as a function of the accelerating voltage, showed the typical irregularities found in the ordinary current-voltage plots to be enhanced. The positions of the irregularites were found to be independent of the frequency and dependent on the amplitude of the applied alternating voltage within the range investigated. Results indicated that the resolving power of the method varies inversely with the amplitude of applied alternating voltage. The effect of vapour pressure on the position and evolution of the irregularities was also studied. AUTHOR.

3372. New Transition Produced by Electron Impact in Helium. R. Whiddington and H. Priestley. *Roy. Soc., Proc.* 145. *pp.* 462–464, *July* 2, 1934.—Electrons of energy between 100 and 600 volts, passing through helium at low pressure, have been observed to produce a new excitation transition with associated energy 59·25 ± 0·12 volts. A rough estimate of the probability of the transition is made. It is suggested that it may be due to a double excitation of the helium atom involving the transition of both *s* electrons to *p* states. AUTHORS.

3373. Small Angle Inelastic Electron Scattering in Helium, Neon and Argon. R. Whiddington and J. E. Taylor. *Roy. Soc., Proc.* 145. *pp.* 465–474, *July* 2, 1934.—Experiments have been carried out to measure the relative probabilities of the most probable excitations by electron impact in He, Ne and A. The method is substantially the same as that already described elsewhere and consists of photographing the complete magnetic spectrum on films specially sensitised by an oiling process. Only one excitation ($1\,^1S_0$—$2\,^1P_1$) is involved in He; two at least in A—singlet and triplet ($3\,^1S_0$—$4\,^1P_1$) and ($3\,^1S_0$—$4\,^3P_1$); two at least in Ne—singlet and triplet ($2\,^1S_0$—$3\,^1P_1$) and ($2\,^1S_0$—$3\,^3P_1$). The presence of these various transitions is inferred from photographs which were afterwards photometered—some included in the text of the paper. The variation of probability with electron energy at angles of scattering in the region of 0° between 50 and 400 volts agrees fairly well with the theory of Massey and Mohr for He. A has a similar law of variation—nearly linear with electron energy—but Ne has a maximum in the region of 170 volts, which has not been explained. A very approximate estimate of the absolute probability for He is given and is compared with the computation on theoretical grounds. The agreement is not unsatisfactory in view of the assumptions necessarily made—an experimental value of 68·5 comparing with a computed one of 17·7. This part of the work is not regarded as reliable and is being continued with improved apparatus. AUTHORS.

3374. Probability of Inner-Shell Ionisation of Atoms by Electron Impact. E. H. S. Burhop. *Roy. Soc., Proc.* 145. *pp.* 612–628, *July* 2, 1934.—The probability of ionisation of silver atoms in the L_{III} shell by electron impact has been measured as a function of the energy of the incident electrons for the range of energies $9V_{Ke}$–$18V_{Ke}$, V_K being the ionisation potential of the shell. For this purpose intensity-potential curves for the silver L_α line were obtained for potentials 15–65 kV. A massive target of silver was used and the rays which entered the spectrometer slit were emitted at a small grazing angle to the target face. In this way curves equivalent to thin target curves were obtained. It is predicted that the relative intensity of a number of L series lines should vary with potential for potentials above the K series excitation potential, and the magnitude of this variation should depend upon the relative probability of ionisation of an atom by electron impact in the K and L shells. This is made use of in an attempt to measure this relative probability for silver atoms, and it is concluded that its value measured at twice the respective K and L shell ionisation potentials is certainly less than 0·04. The results of both parts of the investigation are in substantial agreement with Bethe's theory of inner shell ionisation in which the Born approximation is applied to the discussion of the problem. AUTHOR.

3375. Magnetically Self-Focussing Streams. W. H. Bennett. *Phys. Rev.* 45. *pp.* 890–897, *June* 15, 1934.—Streams of fast electrons which can accumulate positive ions in sufficient quantity to have a linear density of positives about equal to the linear density of electrons, along the stream, become magnetically self-focussing when the current exceeds a value which can be calculated from the initial stream conditions. Focussing conditions obtain when breakdown occurs in cold emission. The characteristic features of breakdown are explained by the theory. Failure of high-voltage tubes is also discussed. AUTHOR.

3376. Combined Light and Electron Microscope. W. Knecht. *Ann. d. Physik*, 20. 2. *pp.* 161–182, *June*, 1934.—An apparatus is constructed containing an electric, a magnetic and a light microscope which enables one to observe light and electron-optical images of a kathode one after the other. The electric and magnetic microscopes produce precisely the same images. Combinations of electric and magnetic lenses are investigated and found to give results in agreement with theoretical expectations. The images formed by electron- and light-microscopes are compared; the images are geometrically similar, but may differ considerably in detail. Phenomena are observed with the electron microscope which cannot be observed with an ordinary microscope, namely, (*a*) processes occurring in the boundary layer between an emissive oxide coating and its metallic support; (*b*) extremely thin barium layers. It is shown that the structural image of a crystalline kathode surface may also be obtained by suitable treatment of a kathode on to which oxide has been pasted. J. E. K.

3377. Efficiency and Sensitivity of Braun Tube with Double Concentration. F. Malsch. *Arch. f. Elektrot.* 28. *pp.* 349–355, *June* 7, 1934.—A discussion is given of the means that may be employed in the Braun tube for increasing the spot brightness, the absolute and relative recording velocity and the sensitivity. It is shown to what extent double concentration of the beam may be usefully employed in this connection. For tubes with very efficient small electron sources a recording spot of greater size may be used, the lenses remaining in the neighbourhood of the disc. For tubes with relatively large electron sources and smaller current density, a marked reduction of the size of spot by suitably placed concentrating lenses effects a considerable improvement in efficiency. A. W.

3378. Braun Tube Considered as a Problem in Geometrical Electron Optics. E. Brüche. *Arch. f. Elektrot.* 28. *pp.* 384–390, *June* 7, 1934.—The laws of electron optics which are of fundamental importance in the design of Braun tubes are here collected together and are explained by the discussion of concrete examples. A. W.

3379. A.C. Method for Collector Analysis of Discharge Tubes. R. H. Sloane and E. I. R. MacGregor. *Phil. Mag.* 18. *pp.* 193–207, *July*, 1934.—An A.C. method is described which enables the second derivative of the current-voltage curve of an auxiliary electrode in a gaseous discharge to be obtained directly, provided the discharge conditions are sufficiently stable. This obviates the necessity for double graphical differentiation of the ordinary electron current-voltage curve when the second derivative is required for substitution in Druyvesteyn's distribution equation for electron speeds. The definition and determination of the space potential are discussed at length, and it is shown that the most reasonable point to take in this connection is that at which the second derivative is zero. This point can be obtained by the present automatic method with considerable accuracy. Typical curves are shown to illustrate the application of the method to actual cases. AUTHORS.

See also Abstracts 3091, 3106, 3238, 3255, 3351, 3408.

CONDUCTION IN SOLIDS AND LIQUIDS.

3380. Application of Rectifiers in Measurement Technique. H. Pfannenmüller. *Arch. f. Elektrot,* 28. *pp.* 356–384, *June* 7, 1934.—The rectifiers employed in measurement technique may be divided into two groups, the first comprising the self-controlled rectifiers with only a single current circuit in the simplest case, the second comprising the externally-controlled rectifiers with at least one measurement circuit and one control circuit. The operation of rectifiers is explained and their most important properties are briefly discussed, after which the practical application of rectifiers in instruments and measurements generally is illustrated by numerous examples. With the first type of rectifiers measurements of a.c. currents and potentials, effective power and peak values are given, while the externally controlled type has wider application to the vectorial measurement of a.c., as well as wave form and peak values. A. W.

3381. Electrostatic Peak Voltmeter. E. H. W. Banner. *Journ. Sci. Instruments,* 11. *pp.* 218–223, *July,* 1934.—The conditions for the correct operation of an electrostatic peak voltmeter are given and the correct method of making the return circuit to the filament or heater shown, together with the correction for filament voltage, when required. The use of a metal rectifier is discussed and test results show that its reverse resistance is too low and its forward resistance too high to be of service. Means of increasing and decreasing the range of an electrostatic voltmeter for d.c. and a peak voltmeter for a.c. are shown. Circuit diagrams illustrate each case. AUTHOR.

3382. Balanced Valve Electrometer and Amplifying Circuit for Small Direct Currents. G. P. Harnwell and S. N. van Voorhis. *Rev. Sci. Instruments,* 5. *pp.* 244–247, *July,* 1934.—An extension of the DuBridge circuit is described which allows valves of a fairly wide range of characteristics to be used. The application to the old type FP-54 and to a valve obtained from the Bell Telephone Laboratories is described. A very stable d.c. amplifier is also described which may be used independently for the measurement of currents of the order of 10^{-12} ampere or in the output of an electrometer valve circuit. AUTHORS.

3383. Measurement of Resistances of the Order of 10^{12} Ohms with a Sensitive Ballistic Galvanometer. J. H. J. Poole. *Roy. Dublin Soc., Proc,* 21. 6. *pp.* 57–58, *June,* 1934.—A h.t. battery charges a standard condenser for a known time through the high resistance. The condenser is then discharged through a senstive ballistic galvanometer. By suitable choice of the duration of charge the ballistic throw can be made a few hundred times as great as the steady deflection produced by the charging current. The insulation resistance of the condenser need not exceed that under measurement. T. I. J.

3384. Influence of the Anharmonic Part of the Thermal Oscillations of Atoms on the Electrical Resistance of Metals. A. Smirnov. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 599–606, 1934. *In English.*—The author explains how the discrepancy between the results of the theoretical calculation of the electrical resistance of metals at high temperature and the results of experiment can be removed by taking into account the non-harmonic character of the thermal oscillations of the atoms of the metal which cause thermal expansion. J. J. S.

3385. Theory of Supraconductivity. R. Schachenmeier. *Zeits. f. Physik,* 89. 3–4. *pp.* 183–209, *May* 24, 1934.—Further develops the author's theory [see Abstract 2542 (1932)] by showing that at low temperatures conduction electrons whose eigenvalues lie near the so-called critical points corresponding to the Bragg condition, undergo no appreciable scattering in collisions with elastic waves (thermal motion of the crystal lattice). The quantum states which become possible owing to the degeneracy of the system composed of conduction and series electrons, are determined for the case of a non-zero lattice potential. Objections to the theory, put forward by H. Bethe, are answered. W. S. S.

3386. Behaviour of Supraconductors in Magnetic Fields. J. N. Rjabinin and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion*, 5. 4. *pp.* 641–643, 1934. *In German.*—Up to the present it has been assumed that the sole difference between a conductor and a supraconductor is that the conductivity of the latter is infinitely great. A simple experiment is described in which the magnetisation curve of a supraconductor has been measured for fields up to the critical field. The relation of B to H in an increasing field is simple and is that expected for a metal of infinite conductivity but in a decreasing field the effect is complicated and the assumption of an infinite conductivity is not sufficient to account for the observed behaviour. A marked hysteresis effect is observed; this is being investigated further. H. J. H. S.

3387. Electrical Resistance of Electrodeposited Films of Nickel. R. C. L. Bosworth. *Faraday Soc., Trans.* 30. *pp.* 549–554, *July*, 1934.—Thin nickel film 0·08 μ thick and thicker has been prepared by electrodeposition on polished stainless steel. The deposit has been coated with shellac and peeled off. Suitable methods for dissolving away the shellac and thus obtaining thin strips of nickel are given. The resistance of these strips is about twice that to be expected from their thickness, and the temperature-coefficient about 2/3 of that of nickel in the bulk form. The resistance of film 0·08 μ thick shows, on heating, a big jump at 50° C., which disappears when the film is annealed at 80° to 100°, but reappears after the film has been kept at room-temperature for a few days. AUTHOR.

3388. Physical Properties of Fe-Al Alloys. C. Sykes and H. Evans. *Roy. Soc., Proc.* 145. *pp.* 529–539, *July* 2, 1934.—An account is given of measurements of the resistivity of alloys of iron and aluminium containing from 11–16 % aluminium by weight. It is shown that the resistivity of such alloys at room-temperature depends on the rate of cooling of the specimens from a temperature of the order of 600° C. Alloys in this range consist of a single solid solution at all temperatures concerned. It is concluded, therefore, that rearrangement of atoms takes place in the alloys under slow cooling conditions, and the more regular arrangement so produced leads to a decrease in resistance. Experimental results are described suggesting that the rearrangement of atoms in the space-lattice takes place over a considerable range of temperatures even under conditions of very slow cooling. AUTHORS.

3389. Anomalous Currents in Dielectrics. Part I. Rock-Salt. Part II. Glass. A. D. Goldhammer and N. A. Salessky. *Phys. Zeits. d. Sowjetunion*, 5. 4. *pp.* 523–552, 1934. *In German.*—A method is described for measuring the current flowing in dielectrics at very short time intervals of the order of 0·0005 sec., after the application of the voltage. With rock-salt, the effect of surface charges on the short-time measurements of the current is eliminated by the use of a guard-ring; no such effect of surface charges is observed for glass. The current decreases at first rapidly with time, then more slowly until finally a constant value (i_r) is reached. With rock-salt, the initial decrease of current is more rapid the higher the temperature. The relation between the current (i) and time (t) is $i = A_1e^{-a_1t} + A_2e^{-a_2t} + i_r$, in the case of rock-salt; and $i = At^{-n} + i_r$ approximately, in the case of glass. It is shown that n is constant for temperatures between 0° and 130° C., and has a value of 0·7. A is proportional to $e^{-K/T}$, where T is the absolute temperature.

E. R.

3390. Conductivity of Rock-Salt Crystals. A. D. Goldhammer. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 553–561, 1934. *In German.*—The true conductivity of rock-salt is defined by the author as the conductivity measured at very short time intervals after the application of the voltage. It is shown that the values of back e.m.f. obtained on rock-salt by Beran and Quittner [see Abstract 591 (1931)] are too high, owing to the effect of surface charges. When current flows through the dielectric for some time, the conductivity is increased. It is suggested that this is the explanation of the apparent increase of conductivity with increase of field strength reported by Beran and Quittner, and that there is therefore no departure from Ohm's law. E. R.

3391. Passage of Electrons through the Surface of Rock-Salt Crystals. B. Fischelew. *Phys. Zeits. d. Sowjetunion,* 5. 3. *pp.* 435–442, 1934. *In German.*—A crystal of rock-salt, previously treated with X-rays, is placed in an arrangement so constructed that a stream of electrons can be directed on to the surface of the crystal, which can also be illuminated at the same time. An electrode in contact with the back surface of the crystal is connected to an electrometer. In the dark it is found that the displacement current produced by electron bombardment sinks to zero in 15 to 20 sec. When the crystal is illuminated with white light, however, the current does not drop to zero but to a definite value, which then falls off very slowly. Experiments with monochromatic light show that the spectral distribution curve of this effect has two maxima at about 460 $m\mu$ and 475 $m\mu$ respectively. The results are explained as due to the formation of a surface charge and a simultaneous partial passage of the electrons into the crystal. The electrons passing into the interior are bound in a certain energy level, from which they are liberated by the light. L. A. W.

3392. Diffusion and Electrolytic Conduction in Crystals. Part II. W. Jost. *Zeits. f. phys. Chem.* 169. *Abt.A.* 1–2. *pp.* 129–134, 1934. —Previous work [see Abstract 3762 (1933)] on the relationships between the solution work, and threshold energy as applied to electrolytic conduction and diffusion had led to the calculation of values of the correct order of magnitude. It was shown that, assuming the dependence of the threshold energy in the lattice constant, and the temperature, an additional factor was obtained which cleared up some of the earlier anomalies. If the premises are correct, the dependence of the electrical conductivity of crystals upon pressure can be deduced. F. J. B.

See also Abstracts 3072, 3105, 3136, 3162, 3268, 3344, 3433.

DIELECTRICS AND CAPACITANCE.

3393. Electric Moments and Infra-Red Spectra, and the Structure of CO. R. S. Mulliken. *J. Chem. Phys.* 2. *pp.* 400–401, *July,* 1934.—The desirability of measurements of infra-red intensities in order to determine electric moments as functions of interatomic distances is illustrated by a discussion of available data on HCl, HI, CO and H_2O. Some new information on the structure of CO is obtained. AUTHOR.

3394. Estimation of Dipole Moments by the Method of Diluted Solutions. M. A. G. Rau and B. N. Narayanaswamy. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 23–44, 1934.—An appropriate apparatus for measuring the temperature coefficients of dielectric constants and densities is described in detail. Discrepancies in the values of dipole moments obtained by different authors for the same substances are discussed. A method based on Hedestrand's is used for calculating the molecular polarisation at infinite dilution; this method gives correct values without reference to atomic polarisation. The dipole moments of pyridine, α- and β-picoline, collidine, quinoline, isoquinoline, quinaldine, piperidine, N-methylpiperidine, and propylidenethylamine were found. The molecular and atomic polarisation are discussed. W. R. A.

3395. Dipole Moments of Substituted Mesitylenes. Frances Brown, J. M. A. de Bruyne and P. Gross. *Am. Chem. Soc., J.* 56. *pp.* 1291–1293, *June*, 1934.—The dipole moments of fluoro-, chloro-, bromo-, iodo- and nitro-mesitylene and of mesitol and fluorobenzene have been determined in solution in benzene at 30°. The moments of the mesitylene compounds are compared with those calculated from the moments of the corresponding mono-substituted benzene derivatives. AUTHORS.

3396. Dielectric Properties of Phenyl-Acetylenes. M. M. Otto and H. H. Wenzke. *Am. Chem. Soc., J.* 56. *pp.* 1314–1315, *June*, 1934.—The replacement of a hydrogen of acetylene with a phenyl group causes a redistribution of electricity such that the compound has a moment of approximately 0·56 *D*. This moment is opposite in direction to that present in toluene. Electric moments have been determined for *p*-chloro, *p*-bromo-, *m*-chloro-, *m*-bromo-, *o*-chloro, *o*-bromo-, *p*-methyl-, *p*-ethyl-, *p*-isopropyl-, and *p*-nitrophenyl-acetylenes. AUTHORS.

3397. Dielectric Constants of Liquid Mixtures of Phenol—Water, Phenol—m-Cresol, Phenol—Aniline, and Phenol—p-Toluidine. O. R. Howell and W. Jackson. *Roy. Soc., Proc.* 145. *pp.* 539–551, *July* 2, 1934.—The dielectric constants of the binary systems phenol—water, phenol—*m*-cresol, phenol—aniline, and phenol—*p*-toluidine have been measured, the first at 70° C. and the other three at 50° C. The form of the curves showing the change of dielectric constant with composition is discussed. There is no parallelism between the change of conductivity and that of dielectric constant with the composition of the mixtures. AUTHORS.

3398. Theory of the Electrical Breakdown of Solid Dielectrics. C. Zener. *Roy. Soc., Proc.* 145. *pp.* 523–529, *July* 2, 1934.—A theory of the electrical breakdown of solid dielectrics is developed. The breakdown is assumed to be due to the direct excitation of electrons by the electric field. Agreement with experiment is obtained both for the magnitude of the breakdown field and for the suddenness with which the breakdown occurs as the electric field is increased. AUTHOR.

3399. Effect of Pressure on Breakdown in Liquid Dielectrics. W. Ferrant. *Zeits. f. Physik*, 89. 5–6. *pp.* 317–356, *June* 2, 1934.—The dielectric strength of pure hexane has been determined with pressures ranging from − 10 to + 40 atmospheres. The curve connecting breakdown voltage and pressure can be divided into three regions: (1) from − 7 to − 1 atmospheres the breakdown voltage increases slightly with pressure, (2) from -1 to $+4$ atmospheres, it increases rapidly, and (3) from $+4$ atmospheres upwards, it increases slightly again. Breakdown in regions (1) and (2) is attributed to action at the electrode surfaces resulting in the formation of bubbles. The voltage gradient at breakdown is independent of temperature up to 160° C., and is independent of electrode separations greater than 0·4 mm. The current-voltage curve shows that the current can be regarded as consisting of two components, each of which increases exponentially with voltage. E. R.

3400. Dependence of the Dielectric Coefficient of Air Upon Pressure and Frequency. A. R. Jordan, J. W. Broxon and F. C. Walz. *Phys. Rev.* **46.** *pp.* **66–72,** *July* **1, 1934.**—A capacity-resistance bridge has been designed to incorporate into an a.c. method of measurement the most desirable features of a previously described electrometer method of determination of the dielectric coefficients of gases. The bridge, which provides for adequate shielding from the effects of solid insulators, has been employed for the measurement of the dielectric coefficient of air at pressures up to 170 atmospheres (18° C.) and frequencies up to 70,000 cycles per second. As in the electrometer measurements, the dieletric coefficient at each frequency employed appeared to increase approximately linearly with pressure. The extreme variation among the measured values of the dielectric coefficient, 1·000589 to 1·000593 at N.T.P., was less than 1 %, and is considered to lie within the experimental error. AUTHORS.

3401. Dispersion and Absorption of Electric Waves. W. Ziegler. *Phys. Zeits.* **35.** *pp.* **476–503,** *June* **15, 1934.**—A summary, with many references, of theories, methods and results on dispersion and absorption (power factors and dielectric constant) of solids, liquids and gases from power frequencies to waves of $\lambda = 10$ cm. W. H. W.

3402. Capacity of Electrode in Presence of Foreign Ions and Electrocapillary Capacity of Mercury. N. Thon. *Comptes Rendus,* **198.** *pp.* **2149–2151,** *June* **18, 1934.**—The symbols having their previous meanings [see Abstract 3013 (1934)] the dispersion of C′ depends on the variation of *l*, and of D with the concentration of the solution. The dispersion observed in a solution containing only foreign ions appears to indicate that D in the passage layer varies with the frequency, that layer behaving as a viscous fluid. This variability of D accounts for the disagreement between the minimum capacity of the polarised Hg electrode as measured with a.c. and a Wheatstone bridge, and that deduced from the electrocapillary curve, better than Frumkin's explanation. [See Abstract 5099 (1933).] C. A. S.

See also Abstracts 3083, 3162, 3291, 3366, 3413.

ELECTROCHEMISTRY.

3403. Electrolysis of Fused Electrolytes. P. Drossbach. *Zeits. f. Elektrochem.* **40.** *7a. pp.* **370–375,** *July,* **1934.**—The theory of electrolysis of fused electrolytes is treated from a mechanical and electrochemical standpoint. The heat balance of the electrolytic furnace is calculated. The significance of the current losses is clearly shown to depend partly on the furnace construction and on the method of escape of the anode fuses. F. J. B.

3404. Kathodic and Anodic Polarisation in Aqueous Alkali Solutions. C. F. Holmboe. *Zeits. f. Elektrochem.* **40.** *7a. pp.* **366–370,** *July,* 1934.—The kathodic and anodic polarisation of electrodes of different metals in aqueous alkali solutions is studied. The effects of time are specially considered, and it is found that time has a very great influence on the magnitude of the polarisation voltage. Incorrect polarisation voltages were obtained when the current was interrupted too soon.

F. J. B.

3405. Electrolytic Properties of Hydrogen. J. A. V. Butler and G. Armstrong. *Chem. Soc., J. pp.* 743–750, *June,* 1934.—In Part I the anodic polarisation of bright Pt electrodes in hydrogen-saturated solutions has been investigated after kathodic polarisation with small currents, and after contact with the solution for a considerable time, a process is observed at $\epsilon_H = +0{\cdot}5$ volt, which is attributed to the ionic solution of H_2 dissolved in the metal. No depolarisation has been observed under these conditions which can be ascribed to the direct action of the H_2 of the solution. In Part II it is shown that after several anodic polarisations to or beyond the point at which O_2 is first liberated in an adsorbed state, depolarisation by the H_2 of the solution takes place near the reversible hydrogen potential with great ease. In this state the kathodic current-voltage curve is linear with the current over a considerable range, and in this and other respects the behaviour is that of a completely reversible electrode. These effects may be accounted for if the anodic treatment causes a change in which (1) the thermionic work function of the metal is reduced ; (2) the adsorption of H_2 at the surface of the electrode and its subsequent passage into solution as H_2 ions are facilitated. A possible cause of such changes is suggested. H. H. Ho.

3406. Acid-Base Reactions Involving Deuterium. W. F. K. Wynne-Jones. *J. Chem. Phys.* 2. *pp.* 381–385, *July,* 1934.—Fom measurements of the rate of neutralisation of a pseudo-acid, nitroethane, in heavy water, a comparison is made of the relative rates of ionisation of H and D atoms, the ratio being approximately 10 : 1. It is shown that these relative rates are of great importance in the study of catalysis by acids and bases in heavy water and some conclusions may be drawn with regard to the mechanism of the inversion of sucrose and of the mutarotation of glucose. These results also have a bearing on the question of D–H exchange in compounds when dissolved in water. AUTHOR.

See also Abstracts 3162, 3268, 3402.

ELECTRONS, POSITRONS AND PROTONS.

3407. Displacement in an Electrostatic Field of Magneto-Electronic Spirals. L. Cartan. *J. de Physique et le Radium,* 5. *pp.* 257–261, *June,* 1934.—For the case of radial symmetry of the magnetic field it is found that the magneto-electronic spirals are trochoids between two circles centred on the axis of symmetry. This property has recently been utilised by Thibaud for collecting charged corpuscles. Thibaud superposed on the magnetic field a uniform electrostatic field, suitably oriented, in order to measure the ratio e/m of the positrons. Calculations are here given of the effect on the electronic spirals of superposing an electrostatic field of any magnitude and direction whatever and the differential equation of the mean trajectory of the spirals is obtained. The magnitudes of terrestrial fields are such as to satisfy the conditions of validity of the formulæ obtained, which may therefore have interesting applications in the physics of the aurora, cosmic rays and similar phenomena. [See also Abstract 813 (1934).] A. W.

3408. Secondary Emission of Tantalum. R. Warnecke. *J. de Physique et le Radium*, 5. *pp.* 267–282, *June*, 1934.—The variation of the number of secondary electrons emitted by a Ta-target is obtained as a function of the velocity of the primary electrons bombarding the target, between 0 and 1000 volts. The best conditions obtainable at a very low pressure (10^{-8} mm. Hg) are used. Nine critical potentials which seem characteristic of Ta are found. Certain of these coincide with critical potentials in X-rays, but no conclusions can be drawn. There is a certain proportion of reflection of primary electrons, but this decreases rapidly with increase of velocity of the primary. H. M. B.

3409. Polarisation of Electrons by Scattering. Part II. E. G. Dymond. *Roy. Soc., Proc.* 145. *pp.* 657–668, *July* 2, 1934.—The author's previous experiments [see Abstract 4560 (1932)] have been extended to higher electron velocities with an improved apparatus. No asymmetry in the scattering which could be ascribed to a polarisation effect greater than 1 % has been observed, up to an energy of 160 kV, whereas Mott predicts a maximum asymmetry of 15 %. The effect previously observed of 1·7 % at 70 kV has been shown not to be real. The influence of stray, inelastic, and plural scattering, and of radiation braking on the results are discussed and are dismissed as being inadequate to account for the lack of agreement. In view of Sauter's confirmation, by another method, of Mott's work, it would seem that modification in the relativistic wave equation is required to account for these results. AUTHOR.

3410. Beilby Layer. G. I. Finch, A. G. Quarrell and J. S. Roebuck. *Roy. Soc., Proc.* 145. *pp.* 676–681, *July* 2, 1934.—Metal vapours have been condensed on polished and etched metal surfaces under observation in an electron diffraction camera. It has been found that (i) suitably polished surfaces gave rise solely to random electronic scattering; (ii) etched surfaces exhibited a crystalline structure; (iii) the diffraction pattern yielded by a crystalline deposit disappeared more or less rapidly when the substrate was polished, but was permanent on an etched surface; (iv) fading of a diffraction pattern occurred without noticeable broadening of the rings; (v) when several layers were formed on a polished surface, the corresponding diffraction patterns vanished at rates decreasing with each successive deposit, and in some experiments the pattern due to the final deposit only weakened to a limit at which it remained unchanged. It is concluded that these facts afford a direct experimental proof of the existence of the Beilby layer and of its formation by polishing. AUTHORS.

3411. Stopping of Fast Particles and Creation of Electron Pairs. H. Bethe and W. Heitler. *Roy. Soc., Proc.* 146. *pp.* 83–112, *Aug.* 1, 1934.—The probability for the emission of radiation by fast electrons passing through an atom is calculated by Born's method, the calculations going beyond previous publications mainly by considering the screening of the atomic field. The results are discussed. The total radiation probability becomes very large for high energies of the electron, indeed the stopping of very fast electrons (energy > 20 mc^2 for Pb) is mainly due to radiation, not to inelastic collisions. The theory does not agree with Anderson's measurements of the stopping of electrons of 300 million volts energy, thus showing that the quantum theory is definitely wrong for electrons of such high energy (presumably for $E_0 > 137\ mc^2$). By the same formalism, the probability for the creation of a positive and a negative electron by a γ-ray is calculated. The energy distribution of the electrons and the total creation probability are shown in form of diagrams. For γ-rays of $h\nu$ between 3 and 10 mc^2 the theory is in very good agreement with the experiments. AUTHORS.

See also Abstracts 3081, 3083, 3104, 3106, 3109, 3372, 3373.

ELECTROSTATICS.

3412. Principle of Conservation of Electricity and the General Problem of Electrostatics. A. Grumbach. *J. de Physique et le Radium*, 5. *pp.* 241–242, *June*, 1934.—The principle of the conservation of electricity together with the principles of thermodynamics permits of establishing simply the existence of the solution of the fundamental problem of electrostatics. Commencement is made by examining the more simple cases of possible distributions and the general solution is obtained by combining linearly the particular solutions. J. J. S.

3413. Charges on Droplets Induced by Spraying. S. Chapman. *Physics*, 5. *pp.* 150–152, *June*, 1934.—The Millikan oil drop method modified and applied to a study of the effect of drop size as related to charge in aneroil (a medicinal hydrocarbon, chiefly octane), nitrobenzene, aniline, glycerin and water. There is no preference for either sign of charge. The larger drops of both signs of charge have the larger charges, and the charge varies roughly in a linear fashion with drop-size except in the case of aneroil. There is a rough parallelism between dielectric constant and charge magnitude for drops of approximately the same size. Although there appears to be no correlation with viscosity, a parallelism between drop-size and surface tension exists which is, however, difficult to differentiate from the parallelism between drop-size and dielectric constant. The phenomena involved here, with slow droplets differ radically from those observed [see Abstract 1446 (1915)] with falling spray-particles. A. D.

3414. Contact Potential in Electrometer Measurements. Part II. E. Rumpf. *Phys. Zeits.* 35. *pp.* 472–475, *June* 15, 1934.—Contact potential phenomena, of importance when using an electrometer at low voltage, are discussed [For Part I see Abstract 5447 (1933)] and related to the Maxwellian equations for heterogeneous dielectrics. The contact potential measured by variation of a condenser connected to an electrometer is that between the plates of the condenser. The author differs from Sienkiewicz [see Abstract 3216 (1933)] in finding that variations of contact potential within the electrometer do not affect the measured voltage. Variations of contact potential of the electrometer affect only the mean capacity of the instrument. W. H. W.

See also Abstract 3381.

MAGNETISM AND ELECTROMAGNETISM.

3415. Quasistatic Magnetic Cycles in Weak Fields. H. Wittke. *Ann. d. Physik*, 20. 1. *pp.* 106–112, *May*, 1934.—Continuing work on magnetic losses of iron and steel in weak field cycles, the author determined the B–H curve for a quasi-static cycle executed by varying the field in six abrupt steps with determination of the corresponding changes in B by a ballistic method. For the magnetic loss in the cycle, as a function of the amplitude of the field variation, the law found differed from that given by Jordan and confirmed by the author [see Abstract 836 1934)] for a.c. cycles down to a frequency of 6·25. The loss represented by the term

$\lambda h^2/2$ in the Jordan expression, is absent for the quasistatic case and this suggests that the loss arises not by hysteresis but as a result of magnetic after-effect. W. S. S.

3416. Ferromagnetic Curie Point for Electrodeposited Nickel Films. S. Procopiu and T. Farcas. *Comptes Rendus,* 198. *pp.* 1983–1985, *June* 4, 1934.—Magnetometric measurements of the remanence of thin films of electrodeposited nickel at increasing temperatures suggest that the ferromagnetic Curie point is 10°–20° C. higher for films of 80–400 $m\mu$ than for those of 4–40 μ thickness. This elevation of the Curie point is attributed to the internal pressure of thin films, which is also considered to account for their high coercive force. It is thus consistent with Heisenberg's theory of ferromagnetism. C. E. W.

3417. Elementary Discussion of Ferromagnetism. F. Bitter. *Roy. Soc., Proc.* 145. *pp.* 629–644, *July* 2, 1934.—The statistical theory of spontaneous magnetisation is discussed based on a model consisting of a geometrical array of magnetic elements, of which only the nearest neighbours interact. It is shown that the usual Weiss-Heisenberg equation is the rigorous solution of this model, assuming that each element is the nearest neighbour to every other element. The correct solution for actual three-dimensional crystals cannot be given, but very probably is characterised by an infinitely steep magnetisation curve in small fields up to a saturation value given by the Weiss equation. A new treatment applicable to the saturation part of the magnetisation curve gives approximately the observed dependence on the number of nearest neighbours at not too low temperatures. Finally an attempt is made to show quantitatively that the discrepancies between the magnetisation curves predicted above and the curves observed for actual iron and nickel crystals in small fields are due to crystal imperfections. AUTHOR.

3418. Permeability Changes in Ferromagnetic Materials Heat-Treated in Magnetic Fields. G. A. Kelsall. *Physics,* 5. *pp.* 169–172, *July,* 1934.—Very high maximum magnetic permeability has been obtained in certain ferromagnetic alloys by slowly cooling them in a magnetic field. In permalloy with 78·5 % Ni it has thus been raised above 140,000, that is, to the same order as is obtainable by rapid cooling without an applied field. In perminvar with 45 % Ni, 30 % Fe and 25 % Co this magnetic heat treatment is also found to be effective. It is also shown that the maximum permeability is highest if the testing field is in the same direction as that of the field applied during cooling. In directions at right angles to this, the maximum permeability is decreased. The ratio of the two permeabilities in one instance was over 14 for permalloy, and in another instance nearly 70 for perminvar. AUTHOR.

3419. Magnetic Susceptibilities of Dilute Solid Solutions of Nickel in Copper at Various Temperatures. W. H. Ross. *Phys. Rev.* 46. *pp.* 46–48, *July* 1, 1934.—New data on the magnetic susceptibilities of the low nickel content end of the nickel-copper alloy series present two main features. At low temperatures an approximation to the usual Curie-Weiss decrease in χ with increasing T is established, while above room-temperature there is an abnormal paramagnetism, χ increasing with increasing T. The variations are continuous with respect to both concentration and temperature. Certain assumptions applied to the Curie-Weiss part of the curves lead to a magnetic moment per Ni atom in the lattice of 0·3 to 0·4 Bohr magneton. AUTHOR.

3420. Paramagnetism of Electron Gas. H. Ostermann. *Zeits. f. Physik,* 89. 1–2. *pp.* 68–82, *May* 15, 1934.—From the assumption of a para-magnetic electron gas there follows the existence of a discharge stream by magnetisation of a conductor, with which an unmagnetised conductor is coupled, whereby a thermal energy exists between different parts of the conductor. For copper the order of magnitude of the effect is 10^{-10} V/°C. at approximately 2×10^4 gauss; the value is considerably higher than the one calculated from Fermi statistics. W. R. A.

See also Abstracts **3080, 3113, 3150, 3160, 3332.**

MEDICAL RADIOLOGY AND ELECTROLOGY.

3421. Elimination of Afterglow and Latent Phosphorescence from Fluorazure (Zinc Sulphide) Intensifying Screens. Part I. General Description. L. Levy and D. W. West. Part II. Physical Investigation. H. A. Edgerton and R. B. Brock. *Brit. J. of Radiology,* 7. *pp.* 344–361; *Disc.,* 361, *June,* 1934.—The authors of Part I have prepared a new intensifying screen which is for practical purposes free from afterglow and latent phosphorescence. Photographs are given showing the elimination of double images, *i.e.,* the superposition of a former exposure on a new one due to after effects. The loss of speed due to elimination of double images is about 30 %, but the screen is still 30 % faster than the Ilford SX. In Part II the authors point out the existence of two after-effects hitherto not realised, which they call latent fluorescence and latent afterglow, besides the two already known, afterglow due to light and to X-ray exposure. The new screens are very much improved as regards light-excited afterglow and only about 1/270 as bright as Ilford SX through X-ray afterglow 5 min. after exposure. In regard to the two new effects these were discovered from the behaviour of the new screens on exposure at a time when the well-known afterglow effects were ineffective. It was found that exposure to red light quenches latent fluorescence by raising the speed of the previously unexposed portions. J. E.

3422. Ultra-Violet Sources and their Radiation. W. E. Forsythe, B. T. Barnes and M. A. Easley. *J.O.S.A.* 24. *pp.* 178–182, *July,* 1934.—Gives data obtained using a number of the new sources of ultra-violet light which have been introduced in the past few years. The measurements were made with the lamps in reflectors and tilted at 30° to the vertical, comparative data for a quartz-mercury arc without reflector also being given. Distributions in the vertical plane, and variations in the ultra-violet output with horizontal rotation of the unit are illustrated by curves, and tables are given showing the variation of the axial intensity of the ultra-violet radiation with the distance from the unit, and the output of several sources. Erythemal ultra-violet is now measured in E-Vitons, this new unit being defined as the erythemally weighted ultra-violet radiation which is equivalent to 10 μW at 2967 Å, and passes through a circle of 22″ dia. with its centre on the axis of the reflector at a distance of 30″ from the source. R. C. F.

3423. Portable Ultra-Violet Meters. A. H. Taylor. *J.O.S.A.* 24. *pp.* 183–184, *July,* 1934.—Describes a new type of d.c. valve amplifier which, owing to its smallness, lightness and portability, is suitable for the measurement of erythemal ultra-violet radiation. Its use as an indicating, and as an integrating ultra-violet meter is described, Cd, or Cd-alloy, photoelectric cells being used. Both meters are capable of measuring very low intensities of light if a CdO photoelectric cell is used in place of the Cd cell. R. C. F.

3424. Ultra-Violet Dosemeter. L. W. Pollak. *Gerlands Beitr. z. Geophys.* 41. 4. *pp.* 458–465, 1934. *English Abstract.*—A new climatological ultra-violet dosemeter was thoroughly tested and very good results were obtained in the laboratory and also in measuring climatological factors. Improvements were made for easier handling of the instrument and for reading the neutral grey scale. These improvements are described. AUTHOR.

3425. 400 kV X-Ray Installation. *El. Rev.* 114. *pp.* 857–858, *June* 15, 1934.—The h.t. equipment of The Cancer Hospital (Free), consisting of two 400 kV constant-potential X-ray generators, is described. Each generator, one used for physical research and one for X-ray therapy, consists of two Greinacher voltage-doubling circuits with one pole earthed, connected back to back, giving a four-valve circuit with 200 kV between each valve and earth, and 400 kV between lines. Full details are given of the transformers, condensers, resistances and switchgear of both sets. J. E. R.

3426. X-Ray Protection Standards. A. Mutscheller. *Radiology,* 22. *pp.* 739–747, *June,* 1934.—Injuries due to X-rays are superficial, affecting the skin, or deep, causing anæmia, blood changes, cell growth, etc. The former class, as a result of education in respect to protection, are becoming less and less. The latter tend to be hidden, until fatal. The present paper reviews protective standards, especially in relation to internal injuries. The physical measurements due to Behnken, Glocker and others, cannot be directly employed to determine protective thicknesses. Scattered radiation has an important bearing biologically, since the erythema dose depends on wave-length and short-wave filtered rays have a large effect on internal organs, blood, etc. The safety tolerance dose, as determined for mixed-wave stray radiation, is different from the analogous dose as determined *via* lead screens. For unknown mixtures of stray radiation the stray dosage should be considered as 50 % and the thicknesses of protective screens should be increased accordingly, this being shewn experimentally by data given in the present paper, calculated for various exciting voltages. It is shewn that the stray radiation from an internally shielded X-ray tube is relatively homogeneous so that the ratio of total stray radiation to filtered stray radiation is small. Stray radiation reflected from glass shields, wood, etc., is highly heterogeneous, so that the relation of total stray radiation to filtered stray radiation, is large. Internal protection of X-ray tubes offers much safer protection than that provided by protection of non-shielded tubes by lead-glass shields, etc. B. J. L.

3427. Radium Protection for Amounts up to 300 Milligrammes. *Bureau of Standards, Handbook No.* 18. [5 *pp.*], 1934.—This handbook contains the second report of the American Advisory Committee on X-ray and radium protection. Details are given of the precautions which should be taken in the manipulation and storage of radium needles in general clinical practice. The question of reducing the exposure of radium workers is considered, and recommendations are made concerning the working conditions in radium departments. J. E. R.

See also Abstracts 3277, 3323, 3345.

OSCILLATIONS.

3428. Mercury-Vapour Lamp as Oscillation Generator. A. Cisman and T. V. Ionescu. *Ann. d. Physik,* 20. 2. *pp.* 183–195, *June,* 1934.—Investigations are described on a mercury-vapour lamp constructed so that control of the current is effected by magnetic reaction. The lamp has two iron anodes and a mercury kathode and can be used either as a l.f. amplifier or as an oscillator. Details are given regarding the characteristic of the lamp and also the conditions for satisfactory operation. With a feed current of 6 A the effective current in the oscillatory circuit was 2·5 A and the frequency could be varied between the limits 50 and 20,000 c/s. Oscillograms showed that under certain specified conditions the current and potential curves were both sinusoidal. Lamps working on similar principles have also been constructed with carbon or metal electrodes and operating at atmospheric pressure. A. W.

3429. String Electrometer as Frequency Indicator. C. Hagen. *Zeits. f. techn. Physik,* 15. 6. *pp.* 231–236, 1934.—Describes an arrangement for indicating fluctuations of frequency about a mean value. A resistor is connected in series with a condenser of the same impedance at the mean frequency. A string electrometer connected so as to indicate the difference between the p.d.'s across them, gives no deflection at the mean frequency, but a deflection at any other value, which indicates in magnitude and direction its deviation from the mean. The total voltage applied to the resistance-capacitance combination is made independent of frequency by means of a thermionic valve used as a voltage limiting device. The frequency scale is linear over the central portion. The application to an extensometer based on the sonometer principle is given as an example. L. H.

See also Abstract 3380.

PHOTOELECTRICITY.

3430. Photoelectric Thresholds of Turned Metallic Surfaces. J. S. Hunter. *Roy. Soc. Edinburgh, Proc.* 54. 2. *pp.* 102–108, 1933–1934. —The photoelectric thresholds were determined for metal surfaces freshly turned on a lathe. The values were found to approximate to those found by other workers for the same metals in the partially out-gassed state, but were at considerably longer wave-lengths than those for completely out-gassed surfaces. It is concluded that a turned surface is one which is partially denuded of occluded gases. D. H. F.

3431. New Photoelectric Effect in Cuprous Oxide. Part I. I. K. Kikoin and M. M. Noskov. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 586–596, 1934. *In English.*—An account is given of preliminary experiments on a new photoelectric effect observed in Cu_2O. When a plate of this material is placed in a magnetic field at the temperature of liquid air and illuminated by white or blue light a p.d. of about 3 to 5 volts is produced between two points at the ends of the plate. The effect is extinguished by red light. The dependence of the p.d. on the intensity of the light was examined and further investigations are to be made. [See Abstract 3068 (1934) and following Abstract.] J. J. S.

3432. Explanation of the Photomagnetoelectric Effect in Semi-Conductors. J. Frenkel. *Phys. Zeits. d. Sowjetunion,* 5. 4. *pp.* 597–598, 1934. *In English.*—The photomagnetoelectric effect discovered by

Kikoin and Noskov in Cu_2O [see preceding Abstract] is explained by the author by a theory based on the assumption that the positive holes left by the escaping electrons have a large mobility comparable with that of the free electrons themselves. When a piece of Cu_2O is locally illuminated the electrons set free instead of being kept back by the positive holes diffuse along with the latter, gradually recombining with them, away from the illuminated place towards the shadowed portions producing increased conductivity of the latter. The effect can be observed at low temperatures only because the conductivity of Cu_2O rapidly increases with increase of temperature. J. J. S.

3433. **Rectifying Properties of Rectifier Photo-Cells. Mrs. Roy-Pochon.** *Comptes Rendus*, 198. *pp.* 2083–2084, *June* 11, 1934.—A large number of selenium rectifier photo-cells were made, and it was found that about 1 % of them did not have rectifying properties. The properties of these cells were compared with those which showed the normal rectifying properties, and the author considers that the photoelectric effect in this type of cell is independent of the rectifying effect. D. H. F.

See also Abstract 3410.

PIEZOELECTRICITY.

3434. **Electrification by Torsion in Quartz Crystals. Ny Tsi-Zé and Tsien Ling-Chao.** *Comptes Rendus*, 198. *pp.* 1395–1396, *April* 16, 1934.—When a hollow cylinder of quartz, the axis of which coincides with that of the crystal, is subjected to torsion a positive charge is developed on its outer surface when twisted in the direction of positive optical rotation, and a negative one on the inner surface, and *vice versa.* The strength of charge is proportional to the couple applied. [See Abstract 1615 (1929).] C. A. S.

3435. **Refracting Interferometer for Examining Modes of Vibration in Quartz Plates. H. Osterberg.** *Rev. Sci. Instruments*, 5. *pp.* 183–186, *May*, 1934.—A more sensitive method for observing longitudinal modes in vibrating piezoelectric plates consists in measuring the changes in the optical path presented by these plates to a beam of light. This is simply and conveniently accomplished by placing the transparent piezoelectric plate in one arm of a Michelson interferometer so that one of the interfering beams passes through the plate. Where a Michelson interferometer is not available, this may be accomplished in the case of a thin plate by means of the thick-film fringes formed by reflecting a beam of light from the two major surfaces of the plate. Changes in the optical path are dominated by the changes in the index of refraction of the vibrating plate. The variations of the index of refraction are markedly greater for the extraordinary ray of a light beam propagated along the Y-axis of a Y-cut quartz plate in which the compressional wave trains are propagated along the X-axis. Preliminary observations regarding the variation of the index of refraction in other crystal cuts are also presented. A brief summary is given of the longitudinal modes which have been observed in plates of quartz and tourmaline. AUTHOR.

3436. **Interferometer Method for Measuring the Amplitude of Vibration of Quartz Bar Crystals. S. H. Cortez.** *J.O.S.A.* 24. *pp.* 127–129, *May*, 1934.—A simple and convenient method is described for measuring the amplitude of vibration of a quartz bar crystal excited piezoelectrically. A silvered face of the quartz bar is substituted for the movable mirror of a Michelson interferometer. White light fringes are employed in the form of a narrow band. When the crystal is made to vibrate the narrow band separates into two bands the separation of which is proportional to the amplitude. **Erratum,** *ibid. p.* 194, *July,* 1934. AUTHOR.

3437. Low-Temperature State of Ammonium Salts. A. Hettich. *Zeits. f. phys. Chem.* 168. *Abt.A.* 5–6. *pp.* 353–362, 1934.—The piezoelectric properties of the crystals were examined by the Giebe-Scheibe method. Ammonium chloride becomes strongly piezoelectric below − 30° C., a result lending support to the theory of the freezing of NH_4-ions. The sulphate becomes weakly piezoelectric below − 51° C.; the bromide gives no piezoelectric response even down to the temperature of liquid air, but becomes doubly refracting below − 30° C. Negative results were obtained on all other ammonium salts tested. P. V.

THERMIONICS.

3438. Supposed Relation between the Exit Work and the Electron Potential Energy in a Metal. K. F. Niessen. *Physica,* 1. *pp.* 623–626, *May,* 1934. *In German.*—Frenkel has given a relation between the exit work and the electron potential energy at the surface of a metal [see Abstract 2489 (1928)]. Bethe has shown that this relation, owing to an error in its derivation, cannot be regarded as valid. The present paper gives further evidence that the supposed relation is not a correct one. A. W.

3439. New Method of Investigating Thermionic Kathodes. C. G. Found. *Phys. Rev.* 45. *pp.* 519–526, *April* 15, 1934.—Under certain conditions, the electron current from a thermionic kathode is determined by the positive ion current reaching it. Two methods of using this relation to measure the thermionic emission of a kathode in a gaseous discharge are described. The constants, $b_0 = 30{,}000$, $A = 10$ for a thoriated tungsten filament, and $b_0 = 22{,}700$, $A = 88$ for an oxide-coated kathode, were obtained by use of these methods. The zero-field emission of an oxide-coated kathode was found to be only about 10 % of the current at which the kathode was normally operated in practical discharge tubes. The increased current is due to the influence at the kathode of an external field which is established by an increase in the rate of generation of positive ions. The emission increases linearly with field up to fields of 150 volts/cm. Use is made of an auxiliary discharge to determine the relative ionising power of electrons of different velocities. With cumulative ionisation predominating, the total ionising power increases linearly with the accelerating potential of the electron for voltages above the resonance potential and up to about two or three times this value. AUTHOR.

3440. Thermionic Work Function and the Slope and Intercept of Richardson Lines. J. A. Becker and W. H. Brattain. *Phys. Rev.* 45. *pp.* 694–705, *May* 15, 1934.—This article is a critical correlation of the slope and intercept of experimental Richardson lines with the quantities appearing in theoretical equations based on thermodynamic and statistical reasoning. From experimental and theoretical arguments it is deduced that the reflection coefficient is probably negligibly small. Hence it is concluded that for most surfaces the work function varies with temperature. This conclusion is to be expected since on Sommerfeld's theory, *w* depends on the number of free electrons or atoms per cm.^{3}, which in turn varies with temperature due to thermal expansion. The photoelectric work function should equal the thermionic work function but should not in general be equal to $- 2 \cdot 3$ times the slope of the Richardson line. The Volta potential between two surfaces having work functions w_1 and w_2 should equal $(w_1 - w_2)k/e$ rather than $2 \cdot 3\ k/e$ times the difference between the slopes of the Richardson lines for the two surfaces. The data from photoelectric and Volta potential measurements support the conclusion that the work function depends on temperature. AUTHORS.

3441. Atomic Work Function of Tungsten for Potassium. R. C. Evans. *Roy. Soc., Proc.* 145. *pp.* 135–144, *June* 2, 1934.—In the experiments here described, the method developed [see Abstract 2093 (1933)] for the measurement of the rate of evaporation of *ions* of the alkali metals from a hot tungsten surface is extended to measure the atomic evaporation rate under the same conditions of very small ($< 1\ \%$) surface concentration. By measuring at different temperatures the rate of change of surface concentration of the adsorbed ions under the influence of a constant arrival rate when *atoms* only are allowed to evaporate, a value of $2 \cdot 80$ electron volts was found for the work required to evaporate a potassium atom from the surface. This value taken in conjunction with the previously measured value of $2 \cdot 43$ volts for the positive ion work function is in very satisfactory agreement with the value $2 \cdot 73$ volts required to close the Born cycle. AUTHOR.

3442. Thoriated Tungsten Filaments. I. Langmuir. *Frank. Inst., J.* 217. *pp.* 543–569, *May*, 1934.—The rate of evaporation of electrons, ν_e, from a thoriated tungsten filament depends on the temperature T and on θ, the fraction of the surface covered by thorium atoms. From data given by Brattain and Becker, making use of the Boltzmann equation, the change in contact potential V of the filament surface produced by the adsorbed thorium is calculated and from this, using an equation previously employed for Cs films on tungsten, the 2-dimensional equation of state of the adsorbed film is calculated. Gibbs' adsorption equation then gives the relation of the atom evaporation ν_a to θ and T. It is thus found that in the range $\theta = 0 \cdot 2$ to $\theta = 0 \cdot 6$, ν_a varies in proportion to $\epsilon^{H\theta}$, where $H = 8 \cdot 1$, a value in good agreement with that of $7 \cdot 8$ given by Brattain and Becker's measurements. Recalculation of the data of numerous experiments in 1921–1923, using the new relations of ν_e to θ, gives results for ν_a as a function of T and θ in good agreement with the values of ν_a calculated from ν_e. The diffusion coefficients of Th through tungsten crystals, along grain boundaries and over the free filament surface, are calculated. A theory is given for the cause of the variation of the surface diffusion coefficient with the number of Th atoms per cm.^{2} and the probable mechanism of the production of metallic Th within the filament is discussed. A. W.

3443. Positive and Negative Thermionic Emission from Columbium. H. B. Wahlin and L. O. Sordahl. *Phys. Rev.* 45. *pp.* 886–889, *June* 15, 1934.—The positive ion and electron work functions have been determined for well outgassed Cb and found to be for the electrons $3 \cdot 96$ volts with A equal to 57 amperes/cm.^{2}/degree^2 and for positive ions $5 \cdot 52$

volts. It has been found that by bombarding the ionisation gauge at a high temperature the specimen could be contaminated so as to change the electron work function by about 16 %. The effect of impurities on the positive ion work function has been studied and it is shown that these will in general cause an increase in this quantity. AUTHORS.

See also Abstract **3376.**

THERMOELECTRICITY.

3444. Longitudinal Thermoelectric Effect. Part I. Copper. P. C. Feng and W. Band. *Phys. Soc., Proc.* 46. *pp.* 515–522, *July* 1, 1934.—The e.m.f. produced by asymmetrical temperature-distributions in a copper wire is examined, and found to agree well with the formula $F = tG + a\,(G.\,G)^{\frac{1}{2}}\,G + b\,(G.\,G)\,G$, where F is the potential-gradient at the point where the temperature-gradient is G. The two constants *a* and *b* are calculated, and their dependence upon tension in the wire investigated. Their values are given by the formulæ : $a\,.\,10^{10} = -\,15{\cdot}5 + 14{\cdot}2\,W + 25{\cdot}0\,\exp\,(-\,W)$, $b.\,10^{12} = 47{\cdot}8 - 20{\cdot}5\,W - 50{\cdot}0\,\exp\,(-\,0{\cdot}45\,W)$, where W is the load in kg. on the wire of dia. 0·885 mm. AUTHORS.

3445. Thermoelectric Forces due to Torsion of Zinc and Cadmium Wires. G. Tammann and G. Bandel. *Ann. d. Physik,* 19. 5. *pp.* 582–584, *March,* 1934.—Curves are given for these metals, and a number of numerical results also for Cu, Ag, Au and Fe. It appears, also, that the percentage increase of the electrical resistance is perceptibly greater for Zn and Cd than for the others. F. I. G. R.

3446. Peltier Effect in Pure Metal Two-Phase Systems. J. Monheim. *Zeits. f. Elektrochem.* 40. 7 *a. pp.* 375–378, *July,* 1934.—It is shown that, for many purposes, the Peltier heat is better considered in terms of molar heat, than in the usual terms, cal.-coulomb. The relationship of this molar Peltier heat to the Peltier coefficient and to other thermodynamic factors is explained. The methods of calculation are illustrated by a collection of pure metal Peltier-heat values, expressed as molar heats, and the behaviour of Peltier heat in certain cases. F. J. B.

3447. Influence of Gas Ions on the Electrothermal Homogeneous Effect. C. Benedicks and C. W. Borgmann. *Arkiv. f. Mat., Astron., och Fysik, Stockholm,* 24 *B. No.* 10. *pp.* 1–5, 1934. *In English.*—By a simple resistometric method (essentially a Wheatstone bridge) measurement was made of the electrothermic homogeneous effect (e.t.h.) in a Pt wire enclosed in an evacuated vessel and kept at a constant temperature. The e.t.h. was found to be a linear function of the p.d. of the ends of the wire. Certain variations were observed which were found to be due to the presence of a gas existing, at least partly, as ions. These ions, probably oxygen, cause a strong e.t.h. opposite to that of platinum. They must possess (at least in preference) a negative charge. The e.t.h. caused by the gas ions may also be due, at least in part, to a true migration of the oxygen towards the positive end of the Pt wire. [See also Abstract 2240 (1934).] J. J. S.